The Beef Cow-Calf Manual

Alberta
AGRICULTURE

AGDEX NO. 42[illegible]

Copies of this publication may be obtained from:

Print Media Branch
Alberta Agriculture
7000 - 113 Street
Edmonton, Alberta, T6H 5T6
OR
Alberta Agriculture's district offices

1981 12 10 M
Reprinted 1983 03 5M

The Beef COW • CALF Manual

Alberta
AGRICULTURE
BEEF CATTLE and SHEEP BRANCH

FOREWORD

The Beef Cow-Calf Manual, first printed in 1975 with minor revisions in 1976, has been well received by Alberta cattle producers with thousands of copies distributed through the offices of district agriculturists.

The present revision is an attempt to keep pace with recent technological advances. This has involved the revision and expansion of existing sections as well as the inclusion of a new section on insect pests affecting livestock. The basic organization consists of eight sections: an overview of the beef industry, management of the herd, nutrition, breeding, animal health, insects, handling facilities and range and pasture management.

The purpose of this manual is to provide a general overview of the beef cattle industry as well as husbandry practices and technical information. The section on management has been expanded considerably and includes calving and reproduction. Feeding guidelines for different classes of cattle are described in the nutrition section. The breeding section deals with the advantages and disadvantages and development of different breeding systems. The animal health section provides a comprehensive overview of cattle diseases including a calendar to use as a reminder for control practices. The final two chapters give information on handling facilities and range and pasture management.

The bulletin is written with the intention of establishing basic principles. It is not a recipe book; for example, the reader will not find dosages for treatment in the health and insect sections. Doses vary from product to product and must be derived from the labels or used on the recommendation of a veterinary practitioner. Technology is rapidly changing, additional information on specific topics is frequently made available through fact sheets which can be easily updated on an annual basis.

I trust this bulletin will be a useful reference for Alberta cattle producers.

H.B. Jeffery, Head
Beef Cattle & Sheep Branch

ACKNOWLEDGMENTS

The department is indebted to Mr. W.C. Gordon, former director of the animal industry division who took time from his retirement to coordinate and develop the manuscript. The assistance of other branches of the department is gratefully acknowledged: especially the Preventive Medicine Branch, Field Crops Branch and Statistics Branch.

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NATURE OF THE BEEF INDUSTRY AND PRODUCTION COSTS

Nature of the Beef Industry

Importance of Beef Production

The cow-calf and beef finishing enterprises on Alberta farms and ranches together make up a very significant portion of Alberta's agriculture. The cow-calf business, which in earlier years was concentrated mainly in southern areas of the province, is now found throughout the province. While southern areas still predominate, it is now more in average size of breeding herd than in total cattle numbers. Significant gains have been made in the grey wooded soil zones during the last two decades.

The beef feeding industry consists of both farm and non-farm feedlot operations. Farm feedlots range in size from small enterprises using surplus feed grains and off-season labor to relatively large feedlots that provide the major source of farm income. Non-farm feedlots are specialized cattle feeding operations. They generally purchase all their feed requirements and either purchase feeder cattle or custom feed cattle for producers and private businessmen on a fee for service basis.

The diversification of farms through cattle production has helped to maintain farm income levels through periods of low world grain prices and low delivery quotas. In addition, it has proven to be a good hedge against such farming hazards as frost and hail. It is a means of utilizing land that is not arable whether by reason of low precipitation, stoniness, poor soil condition or rough topography.

Data from Statistics Canada "Farm Cash Receipts" show the amount of income generated by the beef industry. In 1980, the returns from cattle and calves accounted for $1.28 billion or 39.5% of farm income in Alberta. In comparison, wheat accounted for 19.4% and hogs 5.3%.

Nationally, the 1979 and 1980 Canadian farm income from cattle and calves was $3.51 and $3.83 billion respectively. This compares to incomes of $2.49 and $2.99 billion respectively from wheat.

Location of Beef Production

In January 1981, there were 4.34 million beef cows and heifers on Canadian farms. Of these, 1.62 million head or 37.3% were located on Alberta farms. In contrast, 180,000 head or 7.7% of Canada's female dairy stock were located in Alberta. The presence of over one-third of the total beef breeding herd in Alberta makes this province the heart of the beef industry. Reported slaughter volumes at federally inspected plants further support this statement.

Table 1
Federally Inspected Beef Slaughter, 1980

	No. Head Slaughtered	% Canadian Total
Alberta	1,251,181	40.90
Saskatchewan	185,535	6.06
Manitoba	302,629	9.89
Prairies	1,739,345	56.85
Ontario	993,645	32.48
Total Canada	3,059,483	

Source: Blue Book, Agriculture Canada.

Possibilities for Future Growth

The size of the beef market is determined by the number of beef consumers, their income, the amount of money that they spend on beef and the price of beef. If beef prices are stable relative to other items in the consumers' budget, the major opportunity for growth in the beef market lies with an increase in population. This could result either from population growth in traditional markets or an increase in exports.

The tools of expansion are:

1. Expanding the beef breeding herd.
2. Reducing calf slaughter and directing more calves to the feedlot.
3. Feeding cattle to heavier weights.
4. Improving calving percentages.

Feeding to heavier weights and reducing calf slaughter are the quickest ways to effect some increase. However, there are definite limits as to how much the beef supply can be increased using either of these methods. Improving calving percentages is a good idea in theory but in practice it is difficult to effect a large improvement throughout the total industry. There can be dramatic changes in individual herds but the net effect on the whole industry tends to be relatively small. Future expansion will depend to a large extent on the rate of breeding herd expansion.

Expansion of the breeding herd takes place when profit incentives are present in all phases of the beef industry. As soon as feedlots, packers or retailers feel the cost-price squeeze, it is reflected in the actions of cow-calf operators who in turn cease to expand production.

Expansion of the breeding herd is dependent on an adequate land base. Canada is fast approaching the point where an increase in cow numbers will depend on how

competitive the cow-calf industry is with other types of agricultural production. If it cannot compete economically for land, expansion will be limited. There may still be a few alternatives such as:

1. Further development of marginal land in fringe areas.
2. Better management of existing range and farm land. The breeding herd could be increased through improved range management programs and utilization of rough land on some farms.
3. Utilization of more crop aftermath.
4. Better preserved forage of higher quality through improved forage handling and harvesting methods.

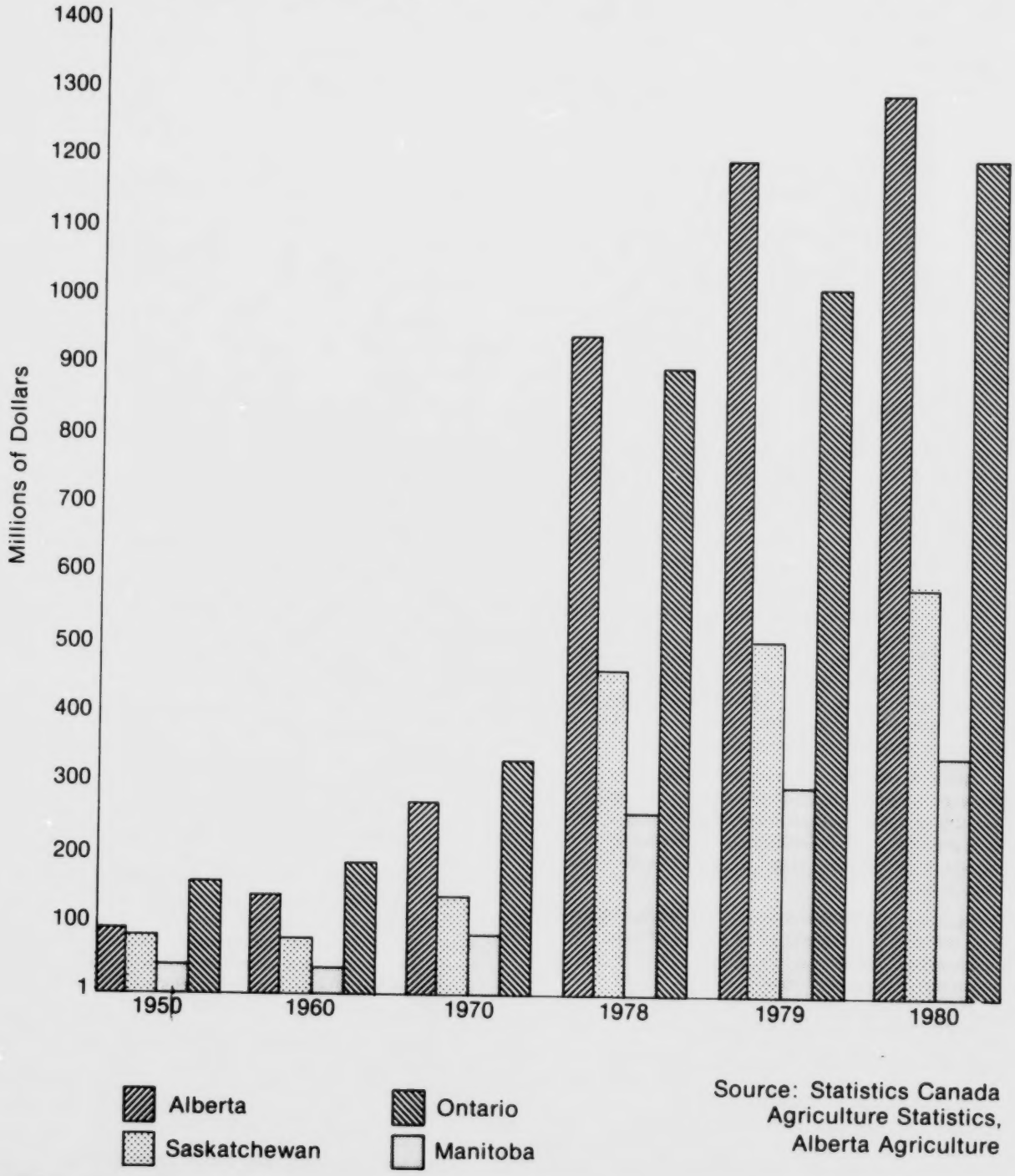


Figure 1. Farm cash receipts from cattle and calves for selected provinces (Millions of Dollars)

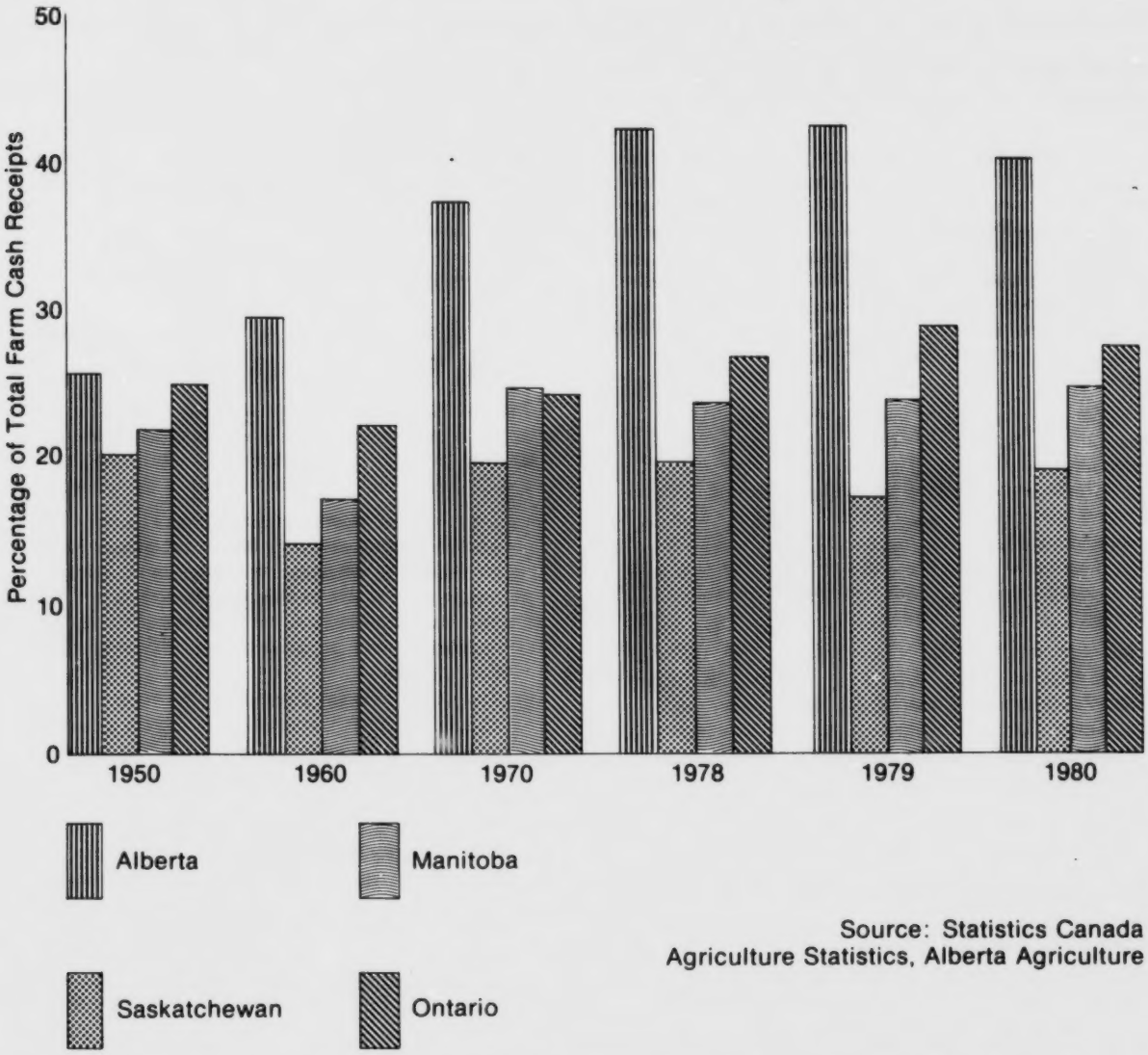


Figure 2. Farm cash receipts from cattle and calves as a percentage of total farm cash receipts for selected provinces

The Beef Cycle

North American beef production is subject to a price and supply cycle of about 10 years. Cattle prices tend to be lowest when beef supplies are largest and highest when they are smallest. Higher prices provide for improved profits to cattle producers and encourage herd expansion. Lower prices result in losses and encourage producers to cut back production.

When prices are high and profits are favorable producers expand their herds by reducing the rate at which they cull older cows and by retaining a larger percentage of heifers for breeding. This action temporarily further reduces the supply of beef that caused the higher prices. By the time beef prices reach the point at which consumers cut back on their purchases and prices level out, the breeding herd has overexpanded.

As soon as prices decline in response to the increase in beef supplies, and profits turn to losses, cows are culled more rigorously and a larger percentage of heifers are marketed as beef rather than retained for breeding. Thus at the very time when beef supplies are burdensome, the action of producers to reduce the beef supply temporarily adds to the problem. Beef prices then decline further to encourage an increase in consumer purchases to absorb the temporary increase in supplies. By the time consumption has increased to absorb the increased supplies, the temporary increase in beef supplies from culled cows and increased heifer slaughter is reduced, and prices begin to improve.

The beef cycle has a particularly important bearing on new producers entering the business as they often are

more dependent on borrowed capital and have a smaller equity cushion to see them through periods of low cattle prices. High interest rates in recent years have also resulted in an increased financial strain on cattle producers.

The challenge for cattle producers is to anticipate price cycles and adjust their production accordingly. Producers face two problems in meeting this challenge. Firstly, there is a two to three year lag between the time the decision to adjust the size of the breeding herd is made and the actual change in the beef supply occurs. Secondly, the time to cut back production is often when prices are highest and cash flow most favorable; conversely the time to expand is often when prices are lowest and cash flow is least favorable.

Modern communication systems and world-wide monitoring of beef supplies should provide sufficient information on which to base decisions. The most difficult part is for the thousands of producers to take the right action at the right time so that the net result is a continuing favorable supply-demand balance. Two key indicators regarding future supply prospects are the number of cows being slaughtered and the ratio of heifers to steers in the beef kill.

Information is available on a continuous basis from the Market Analysis Branch, Alberta Agriculture, CANFAX and *Beef Watch* from the Canadian Cattlemen's Association, The Alberta Cattle Commission and many farm papers. For a detailed discussion of the cattle cycle obtain a copy of the Canadian Cattlemen's Association's publication *The Cattle Cycle*.

The North American Beef Market

The Canadian cattle industry normally operates in a North American market. The United States human population is about ten times that of Canada. Their production of meats is likewise approximately ten times greater. As a result, they have a strong influence on Canadian live cattle and beef markets. Live cattle and beef can move relatively freely between the two countries according to price differentials in the markets. As price spread becomes large enough to compensate for transportation, tariff and currency exchange costs, live cattle and beef may move from the lower to the higher priced market.

The Supply-Demand Balance

For many years Canada was traditionally a net exporter of beef but became a net importer in 1969. The bulk of Canada's beef imports are in the form of manufacturing grade beef from Australia and New Zealand. The largest item of Canadian export is cow beef sold to the United States, the largest beef importer in the world. Quality beef, mainly in the form of finished live cattle, is imported by Canada from the U.S. in varying volumes depending on the Canada-U.S. price differential.

Canadian beef production fell behind consumption in 1969, shifting Canada into a net import position rather than the customary net export position (Figure 3). This change in trade balance persisted through the 1970s.

United States beef and veal imports continued to increase through the 1960s and 1970s. On a carcass weight basis (approximately 25% higher than product weight), 544 million kg (1.2 billion pounds) were imported in 1966, 907 million kg (2.0 billion pounds) by 1972 and 1088.6 million kg (2.4 billion pounds) by 1979. At the same time U.S. exports of beef and veal increased from 39.5 million kg (87 million pounds) in 1966 to 100.7 million kg (222 million pounds) in 1979.

Alberta Beef Production in the Future

There are too many variables involved to allow long-term projections of beef production and beef requirements to be made with any degree of confidence. Some of the factors that will have a bearing on what unfolds in the future are:

1. *Interest rates.* How long interest rates (currently in excess of 20%) stay at or above the present level will have a strong influence on whether or not some producers are able to stay in the business. It could also have a bearing on the ultimate decision of people who may presently be contemplating entering the business.
2. *The rate of inflation.* Currently in the 10 to 12% range and still increasing, inflation is raising input costs faster than producer prices are rising. This is another economic factor that will strongly influence future production.
3. *World demand for grains as food.* This has a bearing on what grains farmers produce and hence on the kind and volume of grain available for cattle feeding.
4. *The grain transportation system.* If the system is improved to the point of being able to carry all the grain for which there is an export market, the effect on cattle production will be different from the situation where grain for export continues to move at present levels.
5. *The decisions of governments, marketing boards,* guaranteed minimum returns on specific commodities, special interest rates to farmers, feed grain policy, feed grain pricing and freight rates are all examples of matters subject to government decision. All have a bearing on future beef production.

Earlier projections of per capita beef consumption reaching 49.9 kg (110 pounds) by 1980 were in fact exceeded as early as 1976. However, by 1980 per capita beef consumption was back down below 40.8 kg (90 pounds). Retail prices reached levels where consumer resistance came into play, there were cheaper alternative products in pork and poultry, and producers had markedly cut production from the peak production years of 1975 and 1976.

Canada will continue to be a beef consuming nation. There will not be a quick return to the 45.4 to 49.9 kg (100 to 110 lb) per capita consumption of the midseventies. Once market share is lost it takes time to win it back. Consumption is more likely to be somewhere between 38.6

and 43.1 kg (85 and 95 lb) per capita for much of the present decade. Increases in the disappearance of dressed beef in the 1980s will therefore be mainly related to population growth unless there is a much greater penetration of export markets than occurred at any time during the previous ten-year period. Alberta should continue to play the dominant role in Canada's beef industry.

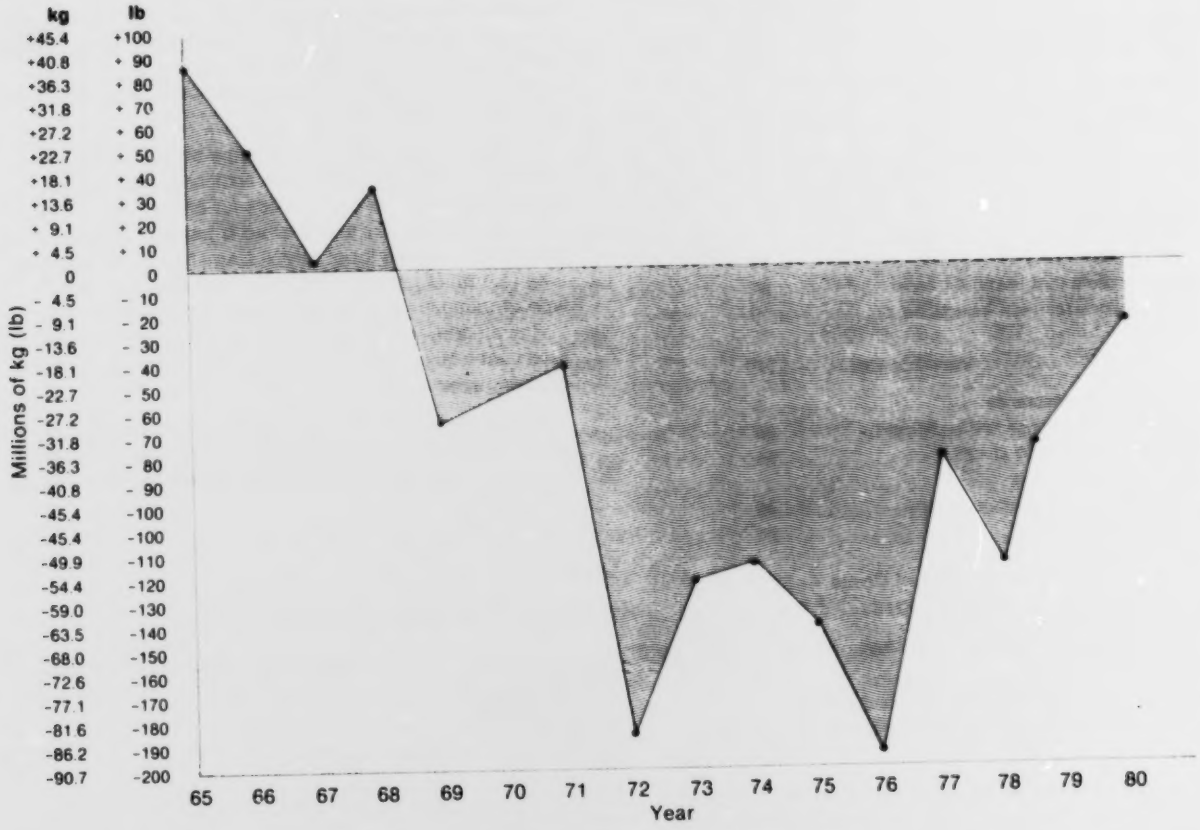


Figure 3. Canadian beef and veal trade, 1965-1980 (Balance + or − in million lb)

Beef Cow-Calf Production Costs

Introduction

Overall production costs in a cow-calf operation show broad year-to-year fluctuations. During the last five or six years costs have also shown a startling increase. Production costs in 1980 were two and one quarter times higher than in 1975.

For many years most of the fluctuation occurred in the area of winter feed cost. In recent years interest on borrowed capital has become a worrisome source of high and fluctuating cost. For purposes of examination and discussion, costs of production are divided into two categories:

(a) overall costs excluding winter feed, and

(b) winter feed costs.

The estimated production costs which follow are based on an assumed management program under which cattle are pastured for six months and fed a wintering ration for six months.

No two farms or ranches have exactly the same production cost. There is, however, a similarity in costs within a geographic area. *Consensus Research Data* from several cow-calf producing areas within the province have been used as a guide in arriving at cost figures in Table 2. Therefore Table 2 should provide reasonably accurate figures for various cost items involved in present day production. A blank column is provided as part of the table for the use of producers who have sufficiently detailed records to allow them to insert their own actual cost figures.

Table 2
Production Costs per Cow (Excluding Winter Feed Costs)

	Cost	Your Cost
Pasture (6 months at $12)	$72	
Salt, mineral and vitamins	10	
Bedding	7	
Veterinary — medicine	7	
Fuel and repairs	18	
Marketing and Transportation	11	
Death loss (1½% of cows)	9	
Cost of replacements (purchase at $100 above price of cull, 15% replacement/yr)	15	
Breeding costs (bull costs, A.I. fees)	20	
Miscellaneous (eartags, insecticide, etc.)	3	
Variable Costs — $172		**$**
Taxes, utilities, insurance	8	
Depreciation (buildings and equipment)	35	
Interest on cow ($540 at 12%)	65	
Interest on investment (buildings and equipment) at 12%	40	
Labor (8 hr at $8.00)	64	
Fixed Costs — $212		**$**
Total Costs (excluding winter feed)	384	
Total Costs (excluding investment return labor and winter feed)	215	

Source: 1980 — Marketing Division and Animal Industry Division, Alberta Agriculture.

Any or all of the above costs may have to be adjusted for individual situations. The total costs, excluding winter feed of $384 include a 12% return on investment and a labor return to the operator of $8.00 per hour.

Winter Feed Costs

Winter feed costs fluctuate from year to year depending on the cost of feed stuffs. Winter feed costs have been developed using three different types of rations. These rations were calculated at National Research Council recommendations for average milking 500 kg (1100 lb) cows with adjustments for Alberta conditions. They include feeding at a maintenance level for early winter and at higher levels for late pregnancy and post calving and until cows go to summer pasture.

Although these rations make some allowance for cold weather, in very cold conditions additional feed will be required to meet the cow's needs for energy. For every 10°C that the midday temperature is below −20°C an additional 3 kg (6.6 lb) of hay, 6.2 kg (13.7 lb) of silage or 2 kg (4.4 lb) of grain should be fed depending on which type of ration is used. If there were 30 days each winter that averaged −30°C as a midday temperature, the winter feed cost would be 4 to 6% higher than those given in the following tables.

Winter feed costs for first calf heifers can be taken from these tables also, since the feed requirements for growing heifers are approximately the same as the requirements for mature cows.

Table 3
Winter Feed Costs per Cow Using a Hay Ration

(Costs based on 10 kg (22 lb) brome hay for 75 days, 11.3 kg (25 lb) brome hay for 45 days and 11.3 kg (25 lb) alfalfa-brome hay for 60 days)

Cost of Alfalfa-brome hay			Cost of brome hay								
¢/kg	¢/lb	¢/kg ¢/lb	2.2 1.0	3.3 1.5	4.4 2.0	5.5 2.5	6.6 3.0	7.7 3.5	8.8 4.0	9.9 4.5	11.0 5.0
2.2	1.0		43	57	71	84	98	112	126	140	154
3.3	1.5		50	64	78	91	105	119	133	147	161
4.4	2.0		58	72	86	99	113	127	141	155	169
5.5	2.5		65	79	93	106	120	134	148	162	176
6.6	3.0		73	87	101	114	128	142	156	170	184
7.7	3.5		80	94	108	121	135	149	163	177	191
8.8	4.0		88	102	116	129	143	157	171	185	199
9.9	4.5		95	109	123	136	150	164	178	192	206
11.0	5.0		103	117	131	144	158	172	186	200	214
12.1	5.5		110	124	138	151	165	179	193	207	221
13.2	6.0		118	132	146	159	173	187	201	215	229

Example: If brome hay costs 6.6¢/kg (3¢/lb) and alfalfa-brome hay costs 7.7¢/kg (3.5¢/lb), the feed cost to winter a 500 kg (1100 lb) cow would be $135.00.

Table 4
Winter Feed Costs per Cow Using a Straw and Grain Ration

(Costs based on 5.4 kg (12 lb) straw and 2.7 kg (6 lb) grain for 75 days, 5.9 kg (13 lb) straw and 4.1 kg (9 lb) grain for 45 days, and 6.4 kg (14 lb) straw and 5.0 kg (11 lb) grain for 60 days)

Cost of Grain			Cost of Straw								
¢/kg	¢/lb	¢/kg ¢/lb	1.1 .50	1.7 .75	2.2 1.00	2.8 1.25	3.3 1.50	3.9 1.75	4.4 2.00	5.0 2.25	5.5 2.50
4.4	2.0		$ 42	48	54	59	65	71	77	83	88
5.5	2.5		50	55	61	67	73	79	84	90	96
6.6	3.0		57	63	69	75	80	86	92	98	104
7.7	3.5		65	70	76	82	88	94	100	105	111
8.8	4.0		72	78	84	90	95	101	107	113	119
9.9	4.5		80	86	91	97	103	109	115	120	126
11.0	5.0		87	93	99	105	111	116	122	128	134
12.1	5.5		95	101	107	112	118	124	130	136	141
13.2	6.0		103	108	114	120	126	132	137	143	149
14.3	6.5		110	116	122	128	133	139	145	151	157
15.4	7.0		118	123	129	135	141	147	153	158	164

Example: If straw costs 3.3¢/kg (1.5¢/lb) and grain costs 11.0¢/kg (5¢/lb) the feed cost to winter a 500 kg (1100 lb) cow would be $111.00.

Table 5

Winter Feed Costs per Cow Based on Cereal Silage and Grain

(Costs based on 16.3 kg (36 lb) silage (as-fed, 65% moisture) and 2.3 kg (5 lb) grain for 75 days, 19.1 kg (42 lb) silage and 2.3 kg (5 lb) grain for 45 days, and 19.1 kg (42 lb) silage and 3.2 kg (7 lb) grain for 60 days)

Cost of Grain			Cost of Silage (as-fed, 65% moisture)								
		¢/kg	.55	1.1	1.65	2.2	2.8	3.3	3.9	4.4	5.0
¢/kg	¢/lb	¢/lb	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25
4.4	2.0		$ 38	56	74	92	109	127	145	163	180
5.5	2.5		43	61	79	97	114	132	150	168	185
6.6	3.0		48	66	84	102	119	137	155	173	191
7.7	3.5		53	71	89	107	125	142	160	178	196
8.8	4.0		59	76	94	112	130	147	165	183	201
9.9	4.5		64	81	99	117	135	153	170	188	206
11.0	5.0		69	87	104	122	140	158	175	193	211
12.1	5.5		74	92	109	127	145	163	181	198	216
13.2	6.0		79	97	115	132	150	168	186	203	221
14.3	6.5		84	102	120	137	155	173	191	209	226
15.4	7.0		89	107	125	143	160	178	196	214	231

Example: If silage costs 3.3¢/kg (1.5¢/lb) and grain costs 8.8¢/kg (4¢/lb) the winter feed cost for a 500 kg (1100 lb) cow would be $147.00.

Above-average management can effect an improvement in percent calf crop weaned and an increase in weaning weights.

The following tables illustrate:

1. How percent calf crop weaned and weaned weight combine to translate into kilograms (or pounds) of calf produced per cow. (Table 6)
2. How the break-even selling price (i.e. the price required to recover production costs) is lowered as weight of calf per cow wintered increases. (Tables 7, 8)
3. How an improvement in percent calf crop weaned is magnified in terms of dollar returns per cow by high average weaned weight and by substantial prices for feeder calves. (Tables 9, 10)

Table 6

Kilograms (or pounds) of Calf Produced per Cow at Various Weaning Weights and Percentage Calf Crop Weaned.

		Weaned Weight								
% Calf	kg	136	159	181	204	227	249	272	295	318
Crop	lb	300	350	400	450	500	550	600	650	700
Weaned										
100		136	159	181	204	227	249	272	295	318
		300	350	400	450	500	550	600	650	700
95		129	151	172	194	215	237	259	280	302
		285	333	380	428	475	523	570	618	665
90		122	143	163	184	204	225	245	265	286
		270	315	360	405	450	495	540	585	630
85		116	135	154	174	193	212	231	251	270
		255	298	340	383	425	468	510	553	595
80		109	127	145	163	181	200	218	236	254
		240	280	320	360	400	440	480	520	560
75		102	119	136	153	170	187	204	221	238
		225	263	300	338	375	413	450	488	525
70		95	111	127	143	159	175	191	206	222
		210	245	280	315	350	385	420	455	490
65		88	103	118	133	147	162	177	192	206
		195	228	260	293	325	358	390	423	455
60		82	95	109	122	136	150	163	177	191
		180	210	240	270	300	330	360	390	420
55		75	86	100	112	125	137	150	162	175
		165	193	220	248	275	303	330	358	385
50		68	79	91	102	113	125	136	147	159
		150	175	200	225	250	275	300	325	350
45		61	72	82	92	102	112	122	133	143
		135	158	180	203	225	248	270	293	315
40		54	64	73	82	91	100	109	118	127
		120	140	160	180	200	220	240	260	280

Source: Marketing Division and Animal Industry Division, Alberta Agriculture.

Table 7
Break-Even Selling Price per Kilogram for Calves

Kilograms of Calf Per Cow Wintered	Production Costs per Cow Wintered								
	300	350	400	450	500	550	600	650	700
113	2.65	3.10	3.54	3.98	4.42	4.87	5.31	5.75	6.19
125	2.40	2.80	3.20	3.60	4.00	4.40	4.80	5.20	5.60
136	2.21	2.57	2.94	3.31	3.68	4.04	4.41	4.78	5.15
147	2.04	2.38	2.72	3.06	3.40	3.74	4.08	4.42	4.76
159	1.89	2.20	2.52	2.83	3.14	3.46	3.77	4.09	4.40
170	1.76	2.06	2.35	2.65	2.94	3.24	3.53	3.82	4.12
181	1.66	1.93	2.21	2.49	2.76	3.04	3.31	3.59	3.87
193	1.55	1.81	2.07	2.33	2.59	2.85	3.11	3.37	3.63
204	1.47	1.72	1.96	2.21	2.45	2.70	2.94	3.17	3.43
215	1.40	1.63	1.86	2.09	2.33	2.56	2.79	3.02	3.26
227	1.32	1.54	1.76	1.98	2.20	2.42	2.64	2.86	3.08
238	1.26	1.47	1.68	1.89	2.10	2.31	2.52	2.73	2.94
249	1.20	1.41	1.61	1.81	2.01	2.21	2.41	2.61	2.81
261	1.15	1.34	1.53	1.72	1.92	2.11	2.30	2.49	2.68
272	1.10	1.29	1.47	1.65	1.84	2.02	2.21	2.39	2.57

Source: Animal Industry Division, Alberta Agriculture.

Example: If production costs are $500 per cow wintered and 204 kilograms of calf are produced per cow wintered, the break-even selling price for the calves would be $2.45 per kg.

Table 8
Break-Even Selling Price per Pound for Calves

Pounds of Calf per Cow Wintered	Production Costs per Cow Wintered								
	300	350	400	450	500	550	600	650	700
250	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80
275	1.09	1.27	1.45	1.64	1.82	2.00	2.18	2.36	2.54
300	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33
325	.93	1.08	1.23	1.38	1.54	1.69	1.85	2.00	2.15
350	.86	1.00	1.14	1.29	1.43	1.57	1.71	1.86	2.00
375	.80	.93	1.07	1.20	1.33	1.47	1.60	1.73	1.87
400	.75	.88	1.00	1.13	1.25	1.38	1.50	1.63	1.75
425	.71	.82	.94	1.06	1.18	1.29	1.41	1.53	1.65
450	.67	.78	.89	1.00	1.11	1.22	1.33	1.44	1.56
475	.63	.74	.84	.96	1.05	1.16	1.26	1.37	1.47
500	.60	.70	.80	.90	1.00	1.10	1.20	1.30	1.40
525	.57	.67	.76	.86	.95	1.05	1.14	1.27	1.33
550	.55	.64	.73	.82	.91	1.00	1.09	1.18	1.27
575	.52	.61	.70	.78	.87	.96	1.04	1.13	1.22
600	.50	.58	.67	.75	.83	.92	1.00	1.08	1.17

Source: Animal Industry Division, Alberta Agriculture.

Example: If production costs are $500 per cow wintered and 450 pounds of calf are produced per cow wintered, the break-even selling price for the calves would be $1.11 per pound.

Table 9

Increase in Gross Returns per Cow from a 5% Increase in Calf Crop Weaned at Given Weaning Weights and Calf Prices*

Calf Prices ¢ per kg	Average Weaned Weight of Calves (kg)							
	113	136	159	181	204	227	249	272
1 10	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00
1 21	6.87	8.25	9.62	11.00	12.37	13.75	15.17	16.50
1 32	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00
1 43	8.13	9.75	11.38	13.00	14.63	16.25	17.88	19.50
1 54	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00
1 65	9.38	11.25	13.13	15.00	16.88	18.75	20.63	22.50
1 76	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00
1 87	10.63	12.75	14.88	17.00	19.13	21.25	23.38	25.50
1 98	11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.00
2 09	11.86	14.25	16.63	19.00	21.38	23.75	26.13	28.50
2 20	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00
2 31	13.13	15.75	18.38	21.00	23.63	26.25	28.88	31.50
2 43	13.75	16.50	19.25	22.00	24.75	27.50	30.25	33.00
2 54	14.38	17.25	20.13	23.00	25.88	28.75	31.63	34.50
2 65	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00
2 76	15.63	18.75	21.88	25.00	28.13	31.25	34.38	37.50
2 87	16.25	19.50	22.75	26.00	29.25	32.50	35.75	39.00

* Increase in gross return per cow in dollars.

Example: At a price of $2.20 per kg and a weaning weight of 181 kg, a 5% increase in calf weaning percentage would increase gross returns per cow by $20.00.

Source: Marketing Division and Animal Industry Division, Alberta Agriculture.

Table 10

Increase in Gross Returns per Cow from a 5% Increase in Calf Crop Weaned at Given Weaning Weights and Calf Prices*

Calf Prices in ¢ per lb	Average Weaned Weight of Calves (lb)							
	250	300	350	400	450	500	550	600
50	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00
55	6.87	8.25	9.62	11.00	12.37	13.75	15.17	16.50
60	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00
65	8.13	9.75	11.38	13.00	14.63	16.25	17.88	19.50
70	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00
75	9.38	11.25	13.13	15.00	16.88	18.75	20.63	22.50
80	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00
85	10.63	12.75	14.88	17.00	19.13	21.25	23.38	25.50
90	11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.00
95	11.86	14.25	16.63	19.00	21.38	23.75	26.13	28.50
1 00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00
1 05	13.13	15.75	18.38	21.00	23.63	26.25	28.88	31.50
1 10	13.75	16.50	19.25	22.00	24.75	27.50	30.25	33.00
1 15	14.38	17.25	20.13	23.00	25.88	28.75	31.63	34.50
1 20	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00
1 25	15.63	18.75	21.88	25.00	28.13	31.25	34.38	37.50
1 30	16.25	19.50	22.75	26.00	29.25	32.50	35.75	39.00

* Increase in gross return per cow in dollars.

Example: At a price of 80¢ per pound and a weaning weight of 400 pounds, a 5% increase in calf weaning percentage would increase gross returns per cow by $16.00.

Source: Marketing Division and Animal Industry Division, Alberta Agriculture.

MANAGEMENT OF THE BEEF HERD
Brood Cow Management

Introduction

One of the most important aspects of a beef herd operation is reproduction. Even though a cow may have the potential to produce a heavy calf at weaning time, she will be a failure if she does not have a calf. The importance of reproduction is sometimes minimized and only receives a passing thought as the herd sire is turned out with the breeding herd and is expected to get all cows in calf.

Unfortunately, producing a healthy live calf from each cow in the herd every 12 months is impossible to achieve without the very best reproductive management. Inadequate levels of nutrition and poor reproductive management of the breeding herd can result in a drastically reduced calf crop.

In order to discuss and evaluate the reproductive management of the beef herd, we must have a method of measuring reproductive efficiency. Percent calf crop is generally used to express breeding or reproductive efficiency and is generally calculated by dividing the total number of calves born by the number of cows bred. The average calf crop in Alberta is below 85%, indicating that reproductive efficiency is a very important economic problem to cattlemen.

Percent calf crop does not give the total economic picture of the breeding herd. Terms such as the percentage of calves weaned or weight of calf weaned per cow bred provide a much better measurement of reproduction, feeding, selection and disease control.

While a herd can be very productive in terms of individual weaning weights, it can be very low when the percentage of calves weaned per cow bred is considered.

Table 11
Effect of Calf Crop Percentage on Average Weight (kilograms or pounds) or Calf Per Cow

%Calf Crop	Average Weaning Weight per Cow Bred									
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
100	272	600	249	550	227	500	204	450	181	400
90	245	540	225	495	208	459	184	405	163	360
80	218	480	200	440	181	400	163	360	145	320
70	191	420	175	385	159	350	143	315	127	280

As an example, (Table 11), if the average weaning weight of a herd were 249 kg (550 lb) but the calf crop was only 80%, the average weaning weight per cow bred would only be 200 kg (440 lb).

In herds where A.I. is practised, the term "services per conception" is a good measure of an individual cow's fertility. On a herd basis, conception rate, expressed as a percentage (number of cows conceived as a percentage of those bred) is a good measure of reproductive efficiency. The term "non-return rate" is often used, but should not be confused with conception rate. The non-return rate is the percentage of the cows bred which did not return for a second service. The nonreturn rate will generally be up to 10% greater than the actual conception rate.

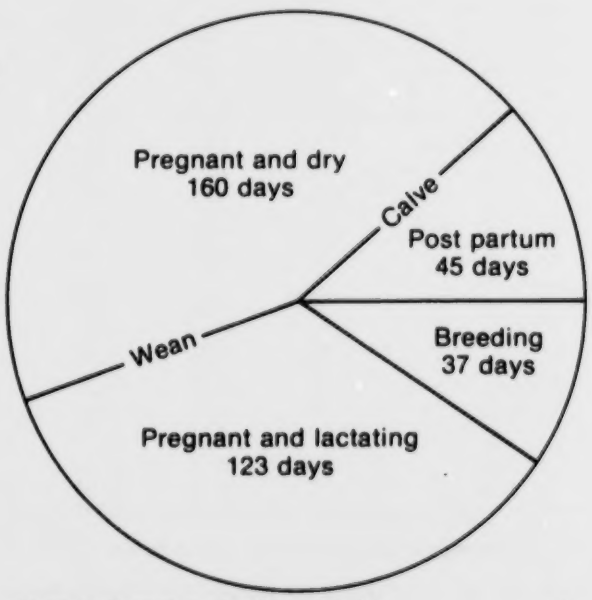


Figure 4. Cow reproductive calendar

Rebreeding

The beef cow has an extremely difficult task in terms of reproduction if she is to wean a calf each year and calve again early the next calving season. The gestation length in beef cows can range from 270 to 300 days while the average is 283-285 days. In general, first-calf heifers tend to have shorter gestations than mature cows and the exotic breeds tend to have a slightly longer gestation period than the British breeds.

As the cow is pregnant 282-285 days of the year, it only leaves 80 days for the cow to be rebred if she is to maintain a yearly calving interval. This is a short period of time considering the cow must recover from the stress of calving and feed her calf while her reproductive tract is returning to its normal size and position (involution) in preparation for its next pregnancy. The time for complete involution is between 30 and 45 days after calving, while it is generally 45 to 60 days before a cow will show her first estrus. The interval from calving to first estrus can be widely variable and can be affected by the age of the cow, the level of nutrition, calving difficulties and uterine infection.

The following table (Table 12) gives an indication of the effect of cow age and time on the return of cows to heat following calving.

Table 12
Percent Cows in Heat at Varying Intervals Following Calving

Age of Cow	Days After Calving						
	40	50	60	70	80	90	100
	Percent						
5 years or older	55	70	80	90	90	95	100
2-3 years	15	30	40	65	80	80	90

Wiltbank, 1969

Only 55% of the older cows and 15% of the 2 and 3 year olds exhibited estrus by 40 days following calving. This age difference was maintained until 80 days post calving when the younger cows seemed to catch up. This difference accounts for a lowered percentage calf crop often experienced the following year. Several factors contribute to the delay in first-calf heifers exhibiting estrus following calving. The fact that these young cows are still growing while nursing a calf puts an extra drain on their system, and they often cannot compete for available supplemental feed when running with older cows.

If a cow does not conceive during her first heat period in the breeding season, it will be another 20 days before she cycles again. Since each heat cycle that a cow misses this year delays her calf approximately 20 days next year, and since a calf may be assumed to gain 0.9 kg (2 lb) per day from birth to weaning, each heat cycle missed means about 18.1 kg (40 lb) less calf at weaning.

By breeding virgin heifers 20 to 30 days prior to the main breeding herd, the extra time will allow first calvers an opportunity to resume their estrus cycle and conceive during the early part of the subsequent breeding season.

First-calf cross bred heifers from breeds with high milk production will often require supplemental feed to achieve an adequate "flushing" before the breeding season. Without this flushing, many researchers and producers have found that high milking heifers will fail to conceive and produce a calf in their second calving season.

The delay in cows showing estrus is also accompanied by a low level of fertility as shown by the conception rates in Table 13.

Table 13
Conception Rate at First Service after Parturition

Days Postpartum	Percent First Service Conception
0-30	33
31-60	58
61-90	69
91-120	74

Other research has indicated that conception rates before 60 days postpartum and after 120 days are low. In fact, many of the cows which fail to conceive within 120 days are problem breeders and will often be open at the end of the breeding season.

The following factors are closely related to good reproductive efficiency in the beef herd and should be considered to obtain or maintain a highly productive herd.

Shorten the Breeding Season

To achieve a more concentrated calving season, the breeding season must be shortened. The traditional length of breeding season has been 90 days. This can easily be reduced to 60 days. Under proper management, a 45 to 60 day breeding period can produce more pounds of calf per cow than a 90 day breeding season under normal management.

Calves from early-calving cows will be heavier and more uniform at weaning. Cows calving late in the breeding season tend to have lighter calves and the cows are more likely to have a poor conception rate as there is less time for the reproductive system to prepare for rebreeding. If the breeding season is prolonged, individual cows in the herd will lose several days each year until eventually they will miss getting rebred.

To prevent a long calving season, allow a maximum 60 day breeding season and cull all open cows based on a pregnancy test in the fall. The open cow will raise her current calf and be sold after weaning. The short breeding season accompanied by pregnancy checking will rid the herd of cows that do not calve early in the calving season each year.

Other aids can be used to help shorten the breeding season. One of the most successful aids has been the use of prostaglandins, which when injected into normally cycling cows will allow them to come into heat 2-3 days

later and be bred by A.I. or bull. Prostaglandins and hormones, however, should not be used as a substitute for good management. These drugs can best be used under good management where the cows are making weight gains prior to the breeding season and where they are close to or have been showing initial signs of estrus.

Short term calf removal where calves have been removed from their dams for 48 hours at 45-50 days after calving, has been beneficial in stimulating estrus on an experimental basis (Table 14).

Table 14
Short Term Calf Removal and Pregnancy

	After 21 Days of Breeding	
	Heat (%)	Pregnant (%)
Control	31	17
Calf Removal for 48 hours	62	44

Adapted from Wiltbank, 1978

Once-daily suckling and early calf weaning have also been beneficial in getting cows rebred in a shorter period of time. However, cattlemen must be aware that early weaning, once-daily suckling and short-term calf removal are at the experimental stage and may not be practical or economically feasible under many farm and ranch conditions.

Effect of Nutrition on Reproductive Efficiency

Inadequate nutrition can affect reproductive efficiency particularly in terms of getting the cow bred again after calving. Nutrition of the cow both before and after calving is important for the cow to exhibit estrus and conceive early in the breeding season. Figure 5 shows the changes in the energy requirement of a cow during the various stages of the reproductive cycle.

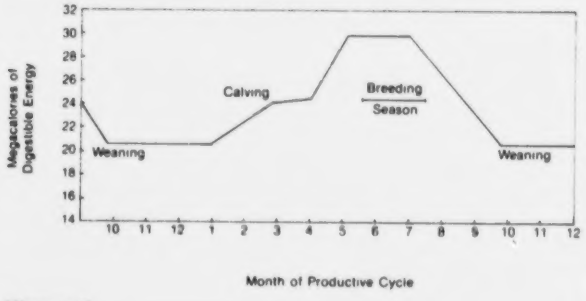


Figure 5.
Energy requirement for a 544 kg (1200 lb) beef cow by stage of production

The nutrient requirement for energy increases by 60% and the protein requirement doubles during the early part of the breeding season when compared to the dry period.

Further evidence of the importance of good nutrition, as demonstrated by the condition of cows at calving, is presented in Table 15. At 80 days after calving only 62% of the thin cows and 88% of the cows in moderately good condition exhibited estrus. Most of the cows in thin condition would be unable to maintain the 12 month calving interval which is necessary for a profitable beef operation.

Table 15
Body Condition at Calving and Heat After Calving

		Days After Calving					
		40	50	60	70	80	90
Body Condition at Calving	No. of Cows	Percent In Heat					
Thin	272	19	34	46	55	62	66
Moderate	364	21	45	61	79	88	91
Good	50	31	42	91	96	98	100

From Wiltbank, Texas Agric. Exp. Stat. (1978)

Culling

Proper culling of the beef herd after the breeding season will improve reproductive performance. All breeding females should be pregnancy tested by a veterinarian at or following weaning. Generally, all open cows and heifers should be culled. In addition, pregnant breeding females should be visually examined for soundness. Those with conditions such as lumpjaw, cancer eye, mastitis, poorly attached udders, poor feet and legs and reproductive problems should be culled. Often these will be older cows which are approaching the end of their productive lives. Culling non-pregnant and poor health risk cows will directly improve calf crop percentages and keep health-related losses in the herd to a minimum. A final additional cull should be made on the basis of performance test records. Cows which produced low indexing calves at weaning should be culled since a low weaning index is indicative of poor milking ability or poor genetic quality. The severity of culling will depend on the individual value of the breeding females, as well as the total number of cows the producer wishes to retain in his herd.

Culled animals should be sold for slaughter so that another producer does not purchase a problem animal. Calves from cows which were culled for physical defects or low performance should not be selected as breeding stock.

Recent research at the University of Alberta and at Arizona State University shows that the value of cull cows can be increased at very reasonable cost if they are properly fed for four to eight weeks before slaughter. The Arizona research showed that in the first five weeks on feed, thin culled cows gained as much as 2.5 kg (5.5 lb) (empty body weight) per day with feed consumption of less than 2.7 kg (6 lb) for each .45 kg (1 lb) of gain. Dr. M.A. Price at the University of Alberta reported in the 1979 *Feeders Day Bulletin* that feeding cull cows for 63 days improved the dressing percentage and the grade. This was reflected in an improvement in both the price per pound and the total value of the cows when sold.

The Arizona study showed that after 35 to 42 days on a high concentrate ration, the cows began to deposit more

fat and the gains became more costly. The profit from feeding cull cows will be influenced by the price of feed, the original condition of the cows, and the price spread between thin cows and cows with improved grades because they are carrying more finish.

Evaluation of the performance of the herd should be done at weaning time since the production cycle is completed. Producers should determine various herd performance indices in order to judge the efficiency of various management techniques and to predict possible future problems. There is no better way to obtain these — percent calf crop — calving frequency — weaning weights — record of animals treated — cost per pound of calf marketed — than by having the herd on a good record-of-performance program.

Beef Cattle Performance Testing

The beef cattle performance testing program (ROP) is a computerized record keeping system designed to assist the manager evaluate production of the herd. It also provides an analysis of individual animals to assist in the selection of replacements or culling of poor producers.

Fertility and growth rate are the two traits most emphasized in ROP programs. Fertility is assessed by calculating calving interval. New techniques are now being developed to estimate in which cycle conception occurs. Growth is determined by evaluating average gain over specific time periods (usually 200-day weaning weight and yearling weight). Selection for these two traits plus culling for undesirable traits encourages improvement in total herd performance.

New versions of the ROP program tend to emphasize total herd performance. The success or failure of breeding or management decisions is best evaluated by looking at the total effect. These new ROP programs provide much useful information with which to evaluate the effects of breed, dam age, fertility level, breeding season as well as other things.

It becomes immediately apparent that more detailed analysis requires more information. Producers who prefer a simple analysis need not shun the program, however, because the new versions of ROP are designed to accept many levels of input and will do all that is possible with whatever is submitted. Producers desiring more answers must submit more information. It is very flexible.

In earlier programs certain basic data were required before the ROP program could function. This is no longer the case. To get specific answers certain groups of data must be collected and are therefore mandatory for that specific program. If data are missing, the computer simply skips that particular analysis and does what it can with the rest.

Basic Data

The basic "data set" required for most analyses would include the following:

— Breeding season
— Cow and calf identification
— Cow and calf age (i.e. birth dates)
— Weaning weight and sex of calf

With these data a thorough analysis can be performed.

Optional Data

By adding breed of sire and dam, I.D. of sire, pregnancy check results, date of service, calving ease, calf condition at birth, reason for calf death losses and by grouping cows by breeding and management group, much additional information can be included in the analysis. Provision is made in some ROP programs to include other producer-specific data sets. These data will simply be listed and recorded on cow histories, but not analyzed.

Interpretation of Results

Calving Interval — The calving interval is a good measure of fertility. If one or a few cows have a long interval it indicates a problem with them. If many cows have long intervals it indicates a management problem or subfertile sires.

Calving interval is considered to have a low heritability. You cannot really affect calving interval by selecting for it. It responds directly to management, however. If high producing cows are the ones with long intervals it indicates they are probably not receiving sufficient feed to meet their high level of production. Under normal conditions where feed is adequate, by culling long interval cows you remove cows that habitually calve late and raise light unprofitable calves.

A new version of evaluating fertility is to determine in which estrus cycle conception occurred. Highly fertile cows that respond adequately to herd management should conceive in the first or second cycle after the bulls are introduced. Major or persistent variations from this denote a problem.

Calving Percent — The next item requiring close observation is calving percentage. Ideally every cow bred and not culled should have a calf. Calves should be born early in the season to have enough time to grow to a large size by weaning time. If the calf crop slips much below 85%, some area of management needs to be improved.

Weaning Weight — This is the first trait mentioned that is considered heritable. At 30% it is only moderately heritable, indicating that weaning weight can be influenced in a major way by nongenetic factors (e.g. pasture condition).

Weaning weight reflects, to a large degree, the milking and mothering ability of the calf's dam. By selecting for weaned weight, the growth potential of the calf will be raised and the milk production of selected female replacements will be greater.

Weaning weight is a very good method with which to evaluate dam performance. Actual weaned weight is preferable to an adjusted 200 day weight. It is important to realize the effect that late calving has on productivity of the cow. The better ROP programs do evaluate the cow on the acutal weaning weight of her calf. Poor producing cows are easy to spot on these programs.

Average weaning weight can be used in a large number of programs to evaluate herd management or breeding decisions. One can compare the production of sires,

pasture types, breeds, cross-breeding programs, and take action on the basis of the comparison, to correct or avoid management problems.

Use of Records for Selection

Other traits are listed and can be used. The important concept to grasp is that a producer must discover his problem area. He must then decide if it is practical or potentially profitable to rectify the deficiency. ROP records and analysis only point out the results of present practices. The decision whether or not to modify production practice must still be made by the producer.

The ROP program also does not say definitely which calves should be selected as replacements or which cows should be culled. It only ranks the animals in the order that they perform in the trait being observed. Whether or not the highest ranking calf should be retained may depend on other traits which have significant influence such as temperament, structural soundness, proper sexual development and size. A live calf is more valuable than a dead or missing one; therefore it might be unwise to cull cows that have small calves at weaning if the alternative is to keep cows who do not regularly raise a calf to weaning.

The ROP program can be a valuable aid to a manager in evaluating the production records of the herd. All cattlemen should keep some records of their herd. Not all will benefit from major ROP programs but all do benefit from keeping track of production of the unit and the results of changes in herd management. ROP is an attempt to help improve profitability of the herd, not just its rate of growth.

How to Enroll — The simplest procedure is to contact your local district agriculturist or personnel of the beef cattle and sheep branch at the nearest regional office of Alberta Agriculture. They will have the necessary forms with which to enroll. Breeders should not overlook ROP programs offered by their breed associations. Some of these programs are excellent, while others are rather simple. You might benefit from looking at a sample of various options offered by different agencies.

Cold Weather Management Strategy

Naturally occurring cold stress does not often present a serious problem of survival for mature beef cattle. Mature cows, bulls and replacement cattle on wintering diets will, however, require additional feed to produce the heat needed to maintain body temperature during periods of extreme cold. See page 44 on winter feed costs. Dr. B.A. Young at the University of Alberta found that the ability of cattle to resist cold stress is determined by the amount of heat produced and the amount of heat insulation provided by the hair coat, hide and subcutaneous fat tissue. If an animal does not receive enough feed to produce the heat required, it will draw on its own tissue reserves. The result could be lowered vigor of the calf or its mother and poor breeding performance the following year. A thin cow is more susceptible to any future cold stress.

Research at the University of Alberta has shown that once wintering beef cattle are conditioned to cold weather, they will remain comfortable to -10 to -20°C still air temperature. Below that temperature, they will seek extra shelter, more bedding or they will increase their normal appetite to supply extra heat energy. It was shown that thin cows were more sensitive to cold stress than fat cows, but because they were lighter, they required 26% less feed for normal maintenance over the winter. This is a considerable saving but it must be balanced against the possibility of less disease resistance and more risk of breeding failure.

During periods of cold weather the ration for thin cows had to be increased by 10 to 30% to meet their energy requirements. Nutritionists in Alberta now suggest that the winter maintenance energy requirements for beef cows should be increased as much as 10 to 15% over the National Research Council recommendations. (See nutrition section of this manual.)

Summary

An understanding of the reproductive cycle and the management necessary for the maintenance of reproductive efficiency is necessary for a profitable beef operation. Shortening the breeding season, pregnancy testing and culling open cows, developing well grown replacements, providing adequate nutrition for production and reproduction are essential in maintaining reproductive efficiency. The goal of each beef cow operation should be the production of a live healthy calf from each cow in the herd at a yearly interval.

Management of the Calf

Calving Time

"The basis of a healthy calf is a healthy pregnancy."

Pregnancy and Nutrition

The nutrition of the cow during pregnancy merits special attention. Proper nutrients in sufficient supply must be provided for the maintenance of the dam and the growth of her unborn calf. Heifers and thin cows require special attention, since they themselves are going through a period of weight gain which requires a high level of nutrition. They should be fed as a group separate from the main herd.

However, it is possible to overfeed the pregnant animal. Overfatness at calving time should be avoided.

Stages of Labor

Stage I — Relaxation

The pelvic girdle through which the calf must pass at the time of birth is normally a firm, bony ring. Just prior to

parturition (calving), the joints and ligaments associated with the pelvic girdle become more elastic and allow both the vertical and horizontal diameters to lengthen to facilitate passage of the calf. The relaxation of the ligaments around the tail head is a sign commonly used to determine cows that are preparing to deliver a calf. Also, the external opening into the birth canal (vulva) becomes swollen and discharges a clear mucous material. The udder becomes noticeably enlarged. The animal will experience discomfort, be restless, separate from the herd, look or kick at its flank, and continually lie down.

Just prior to calving, the muscles of the uterus contract rhythmically, with the time between periods of contraction becoming shorter. These uterine contractions are involuntary, that is, the cow is unable to control them, as they are brought on by the secretion of hormones. The contractions of the uterus force the calf, which is surrounded by fluids and fetal membranes, towards the cervix or neck of the womb. Meanwhile, the cervix itself is undergoing relaxation and the pressure of the contracting uterus forces some of the membranes (waterbag) through the opening. This initiates voluntary pushing by the strong abdominal muscles and ends Stage 1 of labor.

Some Problems in Stage 1

Uterine inertia or loss of activity of the uterus or calf bed. This may be caused by any of a number of factors including poor nutrition, over-condition and milk fever.

All the early signs of pregnancy are seen but the cow fails to commence actively attempting to deliver her calf.

In cases of uterine inertia, professional assistance should be sought.

Nondilation of the cervix. During the pregnancy, the cervix is about the size of an orange and has a very narrow undulating passage through the centre. At the time of parturition, the canal enlarges, partly through the actions of hormones, to allow the passage of the calf.

In cases where the cervix does not dilate, the signs are similar to those described for uterine inertia, in that the dam usually does not go into active labor. Again, a veterinarian should be consulted. Attempts to physically force the passage may result in irreparable damage.

Stage 2 — Active Labor

As the calf enters the birth canal, the involuntary contractions of the uterus are now strongly reinforced by contractions of the powerful abdominal muscles. These combined contractions, plus the movements of the calf, mould the calf to the shape of the birth canal and it is expelled from the dam.

Some Problems Seen in Stage II

Dystocias (difficult birth) are of two types:

Maternal dystocias result from abnormalities of the dam.

Fetal dystocias result from abnormalities in the calf.

Some **maternal dystocias** are caused by:

- — immaturity — the size of the pelvic canal is too small
- — pelvic abnormalities, e.g. fractures, deformations
- — uterine torsion — the uterus has rotated and the vagina is twisted (Figure 7)
- — uterine inertia (as in Stage 1) — usually brought on by fatigue.

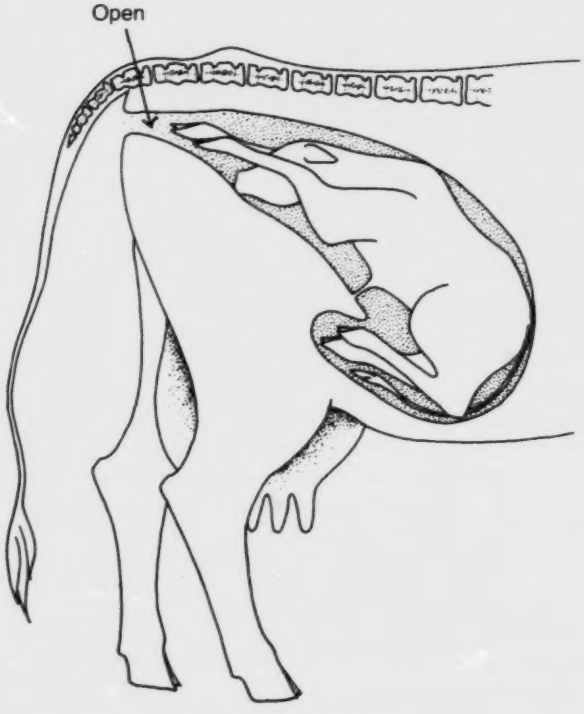


Figure 6. Normal position prior to birth

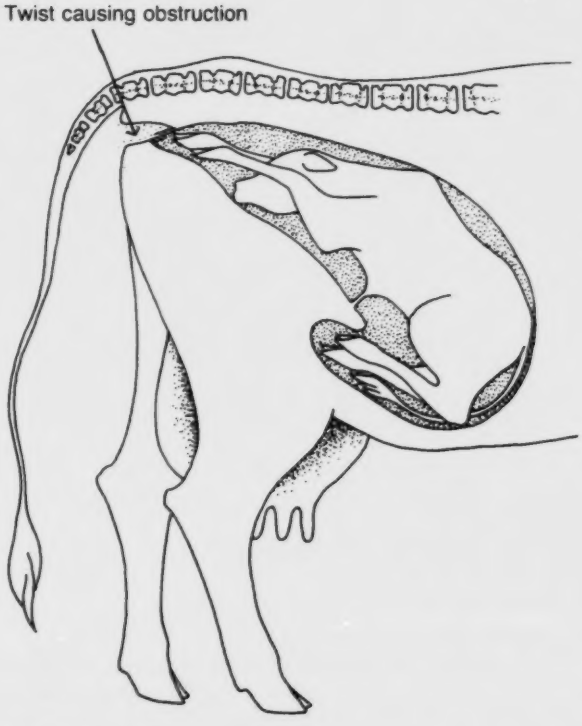


Figure 7. Uterine torsion

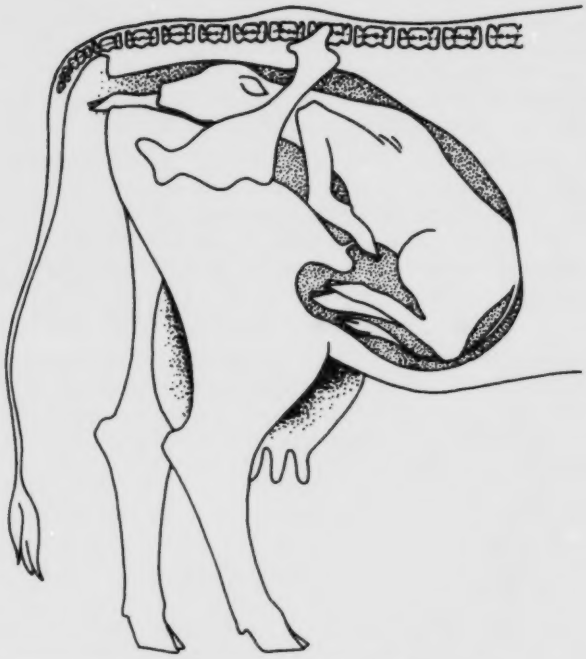


Figure 8. Dystocia caused by postural defects

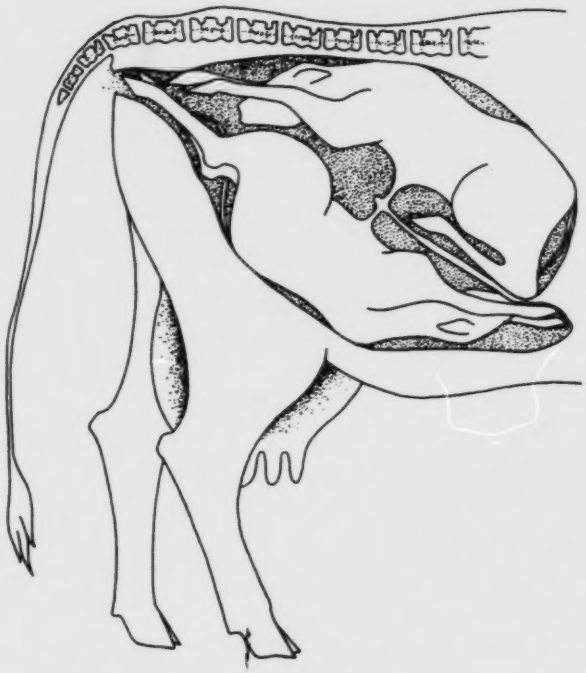


Figure 9. Dystocia caused by twins

Some **fetal dystocias** are caused by:

- — excessive size of calf
- — monster or abnormally formed calf
- — abnormal positioning of calf (Figure 8)
- — multiple births (Figure 9)

Assistance with Dystocia

There are four important rules for a stockman to bear in mind in handling a cow with a calving problem.

1. Know your limitations — This is difficult advice to follow because the greater is one's experience the easier it is to recognize the limitations of any particular method of delivering a calf. In most adult cows the especially difficult deliveries will involve extremely large or abnormal calves, multiple births, uterine twists or a large rotten calf. In each of these cases, the risk of damage to the cow will be minimized if the operator has acquired the skills that are learned previously through experience. In each of these cases the problems are usually associated with the amount of space inside the mother relative to the calf. Again the skills provided by experience can allow the operator to decide whether a caesarean will prevent damage to the mother or loss of the calf.

2. Be clean — Use clean ropes or chains that have been boiled and kept handy in a polythene bag. Wash the cow's external genitalia and your arms with soap and water to which a mild disinfectant has been added.

3. Be gentle — Although force is sometimes needed to extract a calf and although considerable strength and stamina may be needed to correct a displacement, the power used has to be directed with intelligent understanding of what is happening. The art of delivering a calf lies in the ability that permits one to mould the shape of the calf and the vagina in a manner that will most advantageously allow the calf to slide through the pelvis. A combination of judicially used power and an intelligent feeling for the shapes and contours can result in a gentle delivery.

4. Limit the *time* that you *work* on an animal — If distinct progress is not obvious within 20 minutes, call the veterinarian. Loss of time means loss of lubricating fluid, swelling of the vagina and less space to work, exhaustion of the cow and reduced ability to help.

Hints on Calving a Cow

1. Examine the situation and if the nose and two feet are there allow the animal more time to make some progress herself. Far too many stockmen rush in to assist a normal if somewhat slow birth.

2. If you decide to help the animal, get ready first. Assemble your helpers, ropes, chains, lubricants, hot water, disinfectant. Tie the cow's head securely. When you start to interfere there is no time to be lost.

3. Normally a calf will be delivered head first. The head must ALWAYS be dealt with first. If the head is back it must be brought fully into the pelvis. If necessary, a thin rope may be placed around the neck (behind the ears) and the loop drawn tight into the mouth. With the head secured, the limbs may be dealt with. The feet may best be lifted into the pelvis by placing the little hooves in the cup of one's hand. This prevents points from tearing the wall of the uterus.

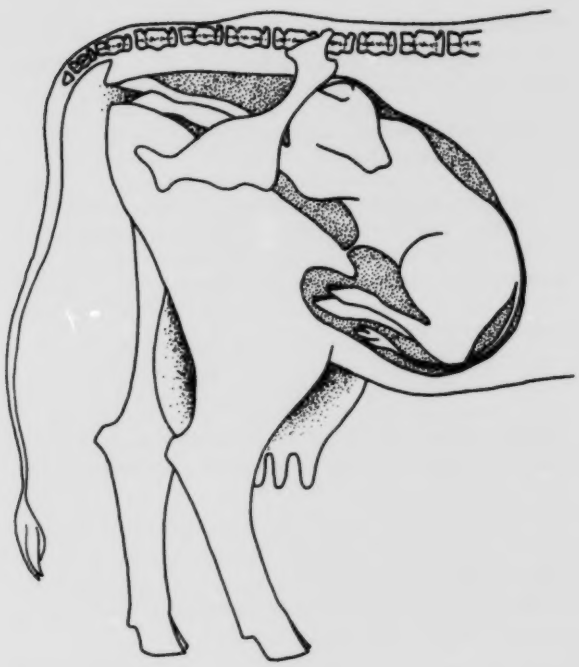


Figure 10. Dystocia caused by lateral deviation of head

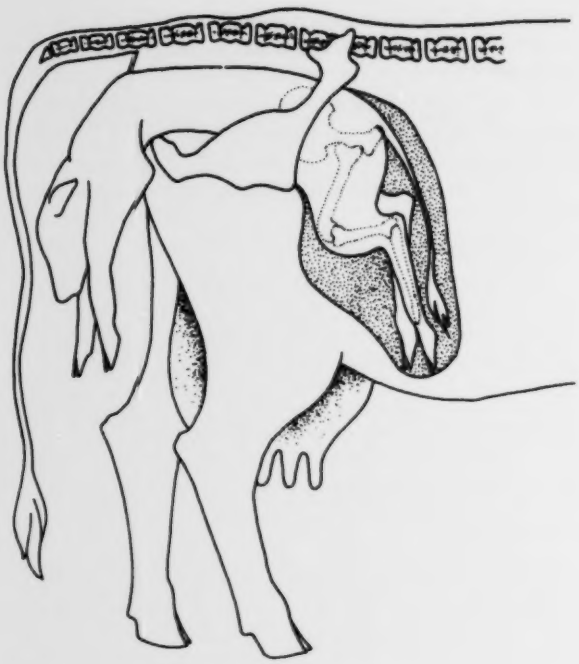


Figure 11. Dystocia caused by hiplock

4. Traction. The calf's elbows may jam on the pelvis brim; therefore they must be eased out one at a time. Sudden traction should be avoided. Pulling first on one leg and then the other copies the calf's normal movement to assist birth and reduces the width of its body. Pulling two legs at the same time greatly increases the diameter of the calf.

If the cow's passage is getting dry, lubricate the calf's coat with lard. Common cooking lard will stick to the coat longer than the more expensive jellies and greases that can be purchased as "obstetrical lubricants".

If the calf sticks at the hips (hiplock), it is best first to introduce some grease (lard) around the hips. Then try to twist the calf on its side. The assistants should commence pulling as the operator presses gently up and down on the calf's middle (Figure 11).

Calf pullers are often used, but all too often they are used unskillfully and the calf or cow is damaged. True, a calf puller can deliver a calf, but power is not a replacement for skill, care and gentleness.

5. The breech (calf coming backwards). A front leg can be easily differentiated from a hind leg. The front leg has one joint, the knee, between the foot and the elbow; in the case of the hind there is no joint between the foot and the hock (Figure 12).

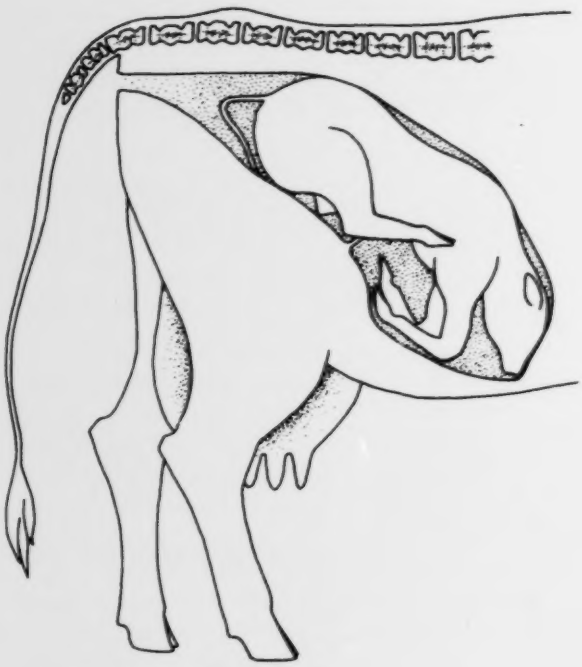


Figure 12. Breech presentation

In a breech delivery, care must be taken that the tail of the calf does not turn back over the thigh, because if it does it may tear the roof of the vagina.

As with the fore limbs more traction must be applied to one limb than the other. If this is not done and an attempt

is made to draw the two hips through the pelvis at the same time, the diameter of the calf will be greatly increased.

6. The foregoing hints cover the simplest needs of the stockman. Attempts to deal with anything more complex are strongly discouraged, and the stockman is advised to recognize as early as possible when professional aid is needed.

Stage 3 — Involution

After the calf has been delivered, the uterus contracts and the placenta (afterbirth) is usually expelled within 6 hours. There is an oozing of blood into the uterus even though the organ itself continues to contract. This blood forms a clot which is normally expelled about a week after calving. Complete involution of the uterus takes up to 30 days.

After Calving Problems

Vaginal Tears

Lacerations or tears of the vagina are commonly seen after calving, especially in heifers. Usually no special treatment is required, unless the tears become infected. In such cases, irrigation with a disinfectant solution and dressing with antibiotic compounds may be required. Intramuscular injections of antibiotics may also be indicated. Deep lacerations require the attention of a veterinarian.

Uterine Tears

If, on examination after calving, it is discovered that the wall of the uterus has been torn, a veterinarian should be consulted immediately, as the cow is in grave danger.

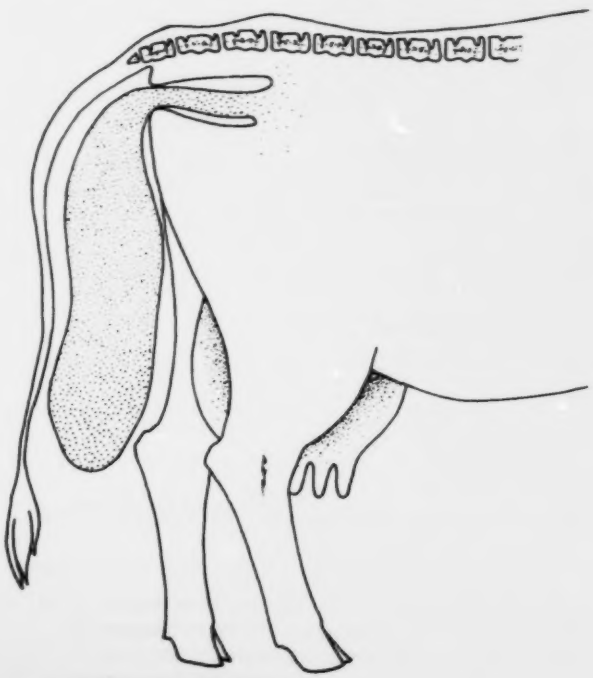


Figure 13. Uterine prolapse

Prolapsed Uterus

Frequently, cows will continue to push after calving and eventually turn the calf bed inside out, so it hangs out behind down to her hocks. This is a serious problem and may sometimes be prevented by forcing the animal to stand and move around.

When a cow has prolapsed her uterus, a veterinarian should be called immediately and the exposed uterus gently wrapped in sheets kept moistened with a warm disinfectant solution.

Obturator Paralysis

When the delivered calf is exceptionally large or when excessive traction has been applied, it is not uncommon for the cow or heifer to be unable to get up on her hind feet. Obturator paralysis, as this condition is called, is caused by damage to the nerves to the hind legs where they pass through the bones of the pelvis. This condition may be confused with milk fever (low blood calcium).

There is no specific treatment for obturator paralysis other than rest in a well-bedded stall and periodically ensuring that the cow's position is changed to prevent bed sores.

It is wise to consult a veterinarian concerning any cow which fails to get up shortly after calving.

Retained Placenta

In normal birth the uterus contracts, expelling all of the fetal membranes within an hour or so of the birth of the calf. When expulsion does not occur, the cotyledons of the membranes solidify and form a firm attachment to the caruncle of the cow's uterus. The attachment will not weaken until the cotyledon starts to disintegrate after four or five days. Attempts to peel off the cotyledon can cause a dangerous hemorrhage. The common practice of trying weights on the placenta hanging from the vulva is also extremely risky.

A stockman may, if he wishes, insert his clean arm into the vagina and GENTLY lift the folds of the placenta through the cervix and allow this to lie in the vagina. This practice is helpful because the cervix contracts quite rapidly and a bulky mass inside the uterus may block the cervical canal. If the bulk of the unattached placenta lies in the vagina the uterus will more readily drain. Many stockmen and veterinarians prefer to place a bacteriacidal agent in the uterus; on the other hand some people consider this unwise because it will delay the decomposition of the placenta.

If an animal with a retained placenta loses her appetite or seems dull and lethargic with a slightly elevated temperature, injections of an antibiotic should be given daily until the problem has been cleared up. After the placenta has been dropped and a few hours have elapsed to allow for drainage, the insertion of antibacterial boluses may be attempted but they must not be forced through the cervical canal in such a manner as to cause damage.

Retained placenta will sometimes cause a reduced ability to conceive. For this reason it is wise to request a veterinarian to irrigate the uterus on about two occasions with an antibiotic solution.

Care of the Calf

Resuscitation — is aimed at establishing proper functioning of respiration and blood circulation.

If the calf fails to breathe within 10-15 seconds of birth, it should be grasped by the hind limbs, lifted from the ground with the head hanging down, and swung back and forth between two men so that the mucous is expelled from the lungs and trachea. The nostrils and mouth should be wiped clean of mucous. Vigorous massage of the chest wall is sometimes helpful as well as allowing the cow to lick the calf.

If necessary, mouth-to-nose resuscitation should be commenced; be sure to use only shallow respiration, as excessive inflation may rupture the calf's lungs.

If there is evidence that the heart has stopped, a sharp slap on the chest over the heart has occasionally been helpful.

Dipping the calf's navel — A wide-mouthed jar of 2.5% iodine solution should be kept handy to the calving pen. As each calf is born, the navel should be thoroughly dipped in the solution to reduce the risk of infection.

Calving to Weaning

The period of time from birth to weaning includes many operations which cause stress. Some of the major ones are dehorning, branding, castrating and vaccinating, in addition to actually weaning the calf. A calf will tolerate almost any stressful procedure much better while still on the cow than after it has been weaned.

If possible one should avoid performing several operations on the calf at one time. Dehorning should be done as soon after birth as is practical. Availability of time and labor usually dictate that branding, castrating and vaccinating are done at one time. Where possible, the cows and calves should be given a few days to "mother-up" and rest before they are moved any great distance if these three operations have been performed at one time.

Calf Identification

Calf Identification — is necessary for performance testing, pedigree, and proof of ownership.

Ear Tagging — has become a popular method of identifying calves for record keeping and performance testing. Ear tags should be large enough that the numbers are visible several yards from the animal. This allows identification of the calf without having to confine or restrain it. Some ear tag losses are inevitable with large plastic tags. To assure permanent identification, the calf can be tagged with a small metal tag in addition to the large plastic tag. Tattoos on purebred or recorded animals provide permanent identification. Ear tagging should be done as soon after birth as is practical.

Tattooing — is required for individual identification under the Canadian Livestock Pedigree Act for all registered and recorded cattle. Unless calves are individually identified in some other manner such as ear tagging, tattooing should be done very shortly after birth. When tattooing, care should be taken to ensure that the letters are securely fastened in the head of the pliers. Test the numbers and letters for proper sequence by applying the pliers to a piece of cardboard. Make sure that the calf's ear is properly cleaned, that the tattoo is properly positioned and applied and that the tattoo ink is well rubbed in. Never use ink that has been frozen.

Branding — is not compulsory but has many advantages. In Alberta a properly recorded brand is evidence under the law that stock carrying that brand is owned by the registered owner of the brand. It is unlawful to use an unregistered brand or a brand for which registration has expired. A brand should be applied in such a manner that it is visible under all conditions, is readable under most conditions and is definitely readable when it is clipped.

The size of the iron is very important. Each character should be not less than 10 cm high and 7.5 cm wide, outside measurements, for calves under one year. An iron 15 cm high and 9 cm wide is recommended for grown cattle.

The hot iron method of branding is still the most efficient. If an iron is at the correct degree of heat, the application should take only 3 to 5 seconds on calves. The job can be done quickly by pressing firmly and rocking the iron slightly to vary the pressure and obtain uniform application of the entire character.

At completion the hide should be the color of buckskin or new saddle leather. Burning too lightly will make only a temporary brand. Holding the iron on too long causes unnecessary pain and excessive burning which may result in a wound which is difficult to heal. A blotched brand resulting from too much heat is difficult to read.

Vaccination

The proper vaccination program for calves will vary somewhat from area to area. The local veterinarian should be consulted to assist in the development of a vaccination program in conjunction with a sound herd health program. The veterinarian will be able to make recommendations for those diseases which are occurring in each area and take into account any unique requirements an individual herd may have. Some general guidelines for a vaccination program for calves in Alberta can be given.

All calves should be vaccinated for the clostridial diseases (blackleg and malignant edema) at branding time. The best age to vaccinate calves for blackleg is two to three months. It is frequently necessary to vaccinate calves at a younger age, before they are turned out to pasture. Calves younger than two or three months of age when vaccinated for blackleg should be given a booster at about weaning time.

Calves should be vaccinated while still on the cow and at least three weeks prior to weaning for viral diseases which constitute a potential problem. These usually include infectious bovine rhinotracheitis (IBR) and parainfluenza-3 (PI_3) and perhaps bovine virus diarrhea (BVD). It has been shown that calves will develop a much greater level of immunity if they are vaccinated when they are not undergoing stressful conditions. If the cow herd has not

been vaccinated for IBR, a veterinarian should be consulted before IBR vaccine is given to the calves if the calves are to be turned back out with the cows.

Castration

Age to Castrate

An increasing number of cattlemen are no longer castrating bull calves. Rapidly maturing animals, if adequately fed, can reach market weight before undesirable sexual characteristics are developed.

Nevertheless, most male animals are castrated and there are widely differing views regarding the desirability of operating at any particular age.

One to Three Months

Young calves suffer little setback, even if castrated at any time from birth to three months of age. When the calves are castrated at a young age there is less risk of flyborne infection, because it is early in the season. However, in areas where urinary calculi are a problem, there is a greater risk of calculi occurring among animals that are castrated at a very young age. Moreover, many believe that poorer growth rates are achieved by the young castrated male.

Six to Twelve Months

If castration does not take place early in the season, it is wise to wait until the fall, when flies will be less abundant. The older the animal is at castration, the greater will be the risk of bleeding, and a temporary reduction in growth rate may be experienced.

Restraint

Young or small animals are most easily castrated when they have been thrown and hobbled. The noose of a length of rope is slipped around the fetlock; the free end is then passed around the neck, pulled up tight, and tied with a quick release knot at the hock. The use of calf tables greatly simplifies the restraint of calves.

In the case of older animals, it is preferable to use a chute. If a chute is not available, the animal may be tied to a fence with a halter with an assistant pushing the calf into the fence and if possible, applying a tail jack at the same time. Tail jacking is an important means of controlling an animal which can inflict considerable damage not only by kicking, but also by driving the knife into the operator's hand.

Castration

The testicle lies inside the scrotum in a membranous bag. This bag is connected directly to the abdomen by means of a tube. Infection can pass along the tube and cause peritonitis, a serious complication (Figure 14).

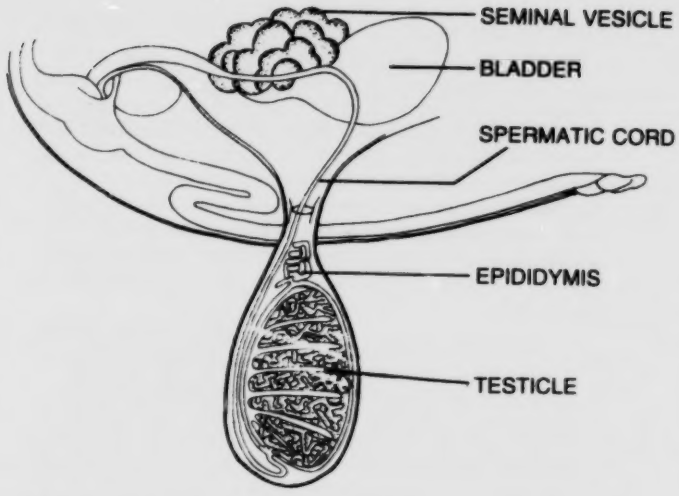


Figure 14. Contents of the scrotum

The testicle is suspended by a cord which contains blood vessels; where the cord is close to the testicle, these vessels are thickened and twisted. Cutting the cord low down will leave a large amount of clotted blood and tubules in the bag. Blood is an ideal medium for bacterial growth. Cutting too high is dangerous only if the animal bleeds and the cord has to be relocated later.

Sometimes parts of the membranous bag or cord will hang from the wound. This encourages the entering of infection and prevents healing.

Surgical Technique

1. Use a sharp knife kept in a container filled with disinfectant solution.
2. Wash your hands and the bull's scrotum.
3. Make a cut along the side of the scrotum to expose the testicle. The cut should be ⅓ longer than the testicle and extend down to the tip of the scrotum. Free the testicle from the membranes which should be peeled back up the cord. If the animal is over six months of age, an emasculator should then be applied and left on for 30 seconds. Cut each side separately. For calves under six months of age, the testicles may be drawn without using an emasculator. In the case of young calves under two months, the whole of the bottom of the scrotum may be cut off. The two testicles will appear; each may be grasped and pulled completely out of the animal's body (Figure 15).

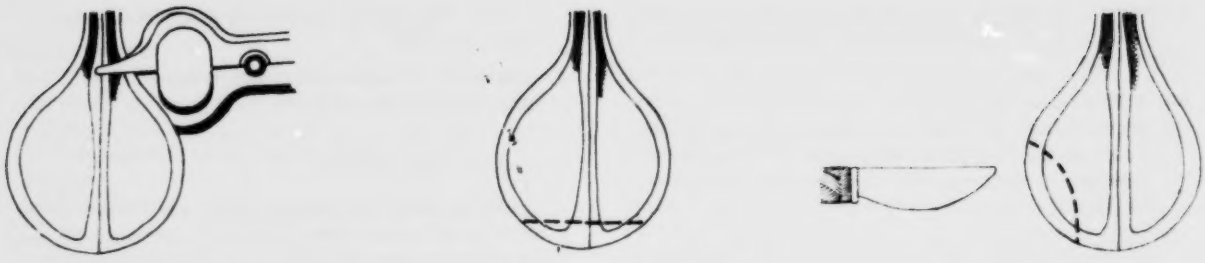


Figure 15. Methods of castrating

4. Immediately after castration, the animals should be closely confined in a bedded area or clean pasture (for cleaniness), and kept quiet for three or four hours (to prevent bleeding).
5. Keep under close observation for five days to observe swelling or stiffness (from infection). Fly sprays may be used if insects are a problem.
6. If the wound swells, or the animal becomes stiff and depressed, isolate it immediately and call the veterinarian. The wound should be bathed with hot water and antibiotics administered. The veterinarian will open and drain the wound.

Bloodless Castration

This is performed by crushing the cord and blood vessels which supply each testicle with an emasculator (e.g. Burdizzo, Figure 16).

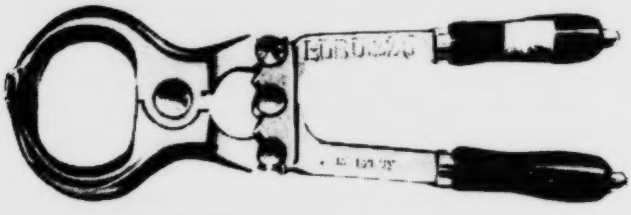


Figure 16. Burdizzo emasculator

Hold a testicle against the outer side of the scrotum and apply the instrument high on the cord and in such a manner that only the cord and a small area of scrotum are crushed. Ensure the penis is not included in the crushed tissues.

Repeat the operation for the second testicle.

Dehorning

The younger that calves are when dehorned, the better the results.

Dehorning During First Month of Life

Caustic

Sticks of caustic may be purchased for the purpose; however, they are an irritant to the human hand, dangerous if allowed to run in the calf's eye and cause problems if rubbed by the calf on the cow's udder. Although caustic may be applied without a local anaesthetic, it is certainly less difficult if the anaesthetic is given.

The hair around the area of the horn base should be clipped. If a horny tip is present, it may be cut off with a knife. Rub the caustic in, using a circular movement and apply over an area no bigger than a quarter. The procedure is complete when the area of application is burnt to just below the skin level. Continued application will damage the bone. The wounds should be allowed to dry before the calf is returned to the mother. Drying prevents the caustic from rubbing off on the cow's udder and burning the skin. In no case should disbudding take place if there is a risk of rain, as the caustic will run, burn the face, and perhaps damage the eye.

Electric Dehorning

Electric dehorners or a hot iron can be used very successfully on young calves to two months of age.

After the iron has been heated to the proper temperature, it is pressed firmly over the horn button and held firmly until the underlying tissue has been cauterized. The burn must be deep enough to destroy the horn tissue but not so deep as to produce a bad sore. Generally, enough heat has been applied when the hot iron is removed and the skin around the base of the horn has a smooth brown leather-like appearance as with a proper brand.

Many producers are using the electric dehorning technique with a specially made iron heated in a branding fire. The ring should be smooth and not over 4-5 cm in outside diameter.

Very little after care is required with this technique. The cauterized area will peel off with the horn bud within four to six weeks leaving the calves resembling naturally-polled animals.

Two to Five Months

This is usually not a good age for dehorning, partly because of the risk of flies and partly because the bones of the skull have not hardened and tend to splinter, allowing infection to enter the skull.

Various instruments are available, but possibly one of the simplest to use is the double action hoof shears, but they must be scrubbed and soaked overnight in a solution such as Hibitane.

The small horns may be quickly cut out by applying the jaws of the cutter close to the head.

Adult Cattle

The horns of adult cattle are most easily and accurately removed if the procedure is performed under a local

anaesthetic. Therefore, if a good cosmetic result is desired for breeding stock, the surgery should be undertaken by a veterinarian.

Equipment

- **Wire** — The use of special cutting wire is slower and much harder physical work than any other system; however, the horn can be cut closer with minimal bleeding.
- **Saws** — Various hand saws can be used, but once the direction of the cut has started, it cannot be changed and bleeding can be excessive.
- **Shears** — Shears are extremely quick and reasonably accurate in skilled hands. For adult cattle the shears tend to be extremely heavy and may splinter and crush bone rather than cut it.

Technique

Whatever instrument is used, the objective must be to attempt to remove 0.6 cm of skin with the horn.

Bleeding

Bleeding at the time of surgery is usually quite profuse, but if the animals are kept quiet the bleeding will usually stop.

If anaesthetic has been used, bleeders may be cauterized with a hot iron or ligated surgically. Dehorned animals will not recognize one another, and if they have been anaesthetized, they will tend to fight among themselves. If fighting takes place, the wounds are likely to open and begin bleeding again. Animals that have not been anaesthetized will be too sore to fight.

When bleeding persists for more than 45 minutes an attempt should be made to apply pressure to the wound by means of a gauze pad and bandage. Should bleeding still continue, the assistance of a veterinarian should be obtained.

Various preparations are available for general use that assist in stimulating clotting of blood.

Complications

The horn is hollow and leads directly into the large sinuses of the head. Thus, when the horn is removed, the sinus will be exposed to the outside air. Frequently, rain will fall in the opening or dirt will be pushed into the opening when the animal rubs its head during the "itchy" healing stage. Sinusitis will result. The animal will suffer from a headache, the eye on the infected side will tend to close and the animal will hang its head to one side. Discharge will be present and may be tipped out by turning the head on one side. Antibiotics such as mastitis ointment are usually quite effective if squirted into the opening. If the discharge has a foul smell, veterinary attention should be sought. If the opening has healed over but the same symptoms are seen, call a veterinarian.

WARNING: Both castration and dehorning present the same dangers.

1. **Bleeding** — ensure that mouldy sweet-clover is not fed for two weeks prior to surgery.
   Twenty-four hour observation is essential. Bleeding may occur after this time if dehorned cattle fight (i.e. mixed in with strange animals) or are subjected to violent exercise.
2. **Infection** — Again, observation is essential for several days after surgery.

Growth Implants

Growth implants have been used for a number of years to increase the rate of gain for weaned calves and yearling cattle in feedlots and on summer pasture. More recently, growth implants are being used for nursing calves.

Two products are available for animals over 181 kg (400 lb). Synovex S (for steers) and Synovex H (for heifers) are natural hormone products while Ralgro is a mold extract which stimulates the animal to produce a combination of growth stimulating hormones. Alberta trials in 1980 showed yearling cattle implanted with these products gained 9.1 to 22.7 kg (20 to 50 lb) more than pen mates left untreated.

At present, only Ralgro is registered in Canada for use on newborn or suckling calves. Calves given a single implant in the spring can usually be expected to gain 4.5 to 9.1 kg (10 to 20 pounds) more than untreated calves.

It should be noted that implanted bull calves had their sexual development severely retarded so bull calves to be used for breeding should not be implanted. Heifer calves given a single implant showed little or no difference in development but a second implant delayed puberty in one U.S. trial reported.

In both calves and yearlings, the growth implants are likely to give the greatest response when the animals are on a generous diet or milk, grass or grain. A shortage of milk or forage due to drought or a deficiency of any essential nutrient in the diet will prevent the animal from reaching its maximum potential for growth. In this kind of situation, the response from the growth implants may be less than expected.

The active agents in growth implants are placed between the skin and cartilage of the animal's ear in the form of pellets which release the material over a period of 60 to 90 days. Animals cannot be slaughtered less than 65 days after the last implant date.

The proper location for the implant is important. For Synovex, the pellet should be placed in the middle third of the ear between the base and tip, being careful to avoid any major blood vessel which might wash out the pellet or cause too rapid absorption. For Ralgro, the recommended site is in the lower portion of the ear about a 2.5 cm from the base of the head. For both products, it is important to read and carefully follow the instructions received at the time of purchase.

Creep Feeding

Cows and calves grazing summer pasture provide the least expensive production system for the beef producer. A cow on good pasture can usually meet her nutritional requirements for optimum milk production. Calves on milk plus good pasture should gain 0.7 to 0.9 kg (1.5 to 2.0 lb) per day depending on the milk production capability of the dam.

Opinions vary on the merit of creep feeding.

Advantages are:

— When pastures dry up in September and October, not even the best milking cow will give enough milk for an early March calf. Calves will often lose weight for the last two months before weaning if they are on poor pasture.

— Creep feeding makes the weaning changeover easier, as calves are already started on feed.

— Gains are put on very efficiently, without danger of overfeeding at an early age.

— Creep feeding may reduce "stealing" which many calves of the larger new breeds seem to do.

— A calf receiving grain will consume less grass so pasture management can be improved.

Disadvantages are:

— Creep feeding can distort the production record on the cow and the performance information on the calf. The weaning weight is no longer only an indication of the cow's milking ability, but also how much grain the calf consumed.

— Feedlot operators may discriminate against calves which appear to have some degree of finish as often is the case with creep fed calves.

— Some calves eat a fair amount of creep feed while some do not eat any.

— The added cost of creep feeders, grain and labor may not be justified if feed prices are high or pasture conditions are good.

Many different creep feeds are available. The best creep feed is the one which is least expensive yet is palatable and contains approximately:

— 1.35 Mcals of digestible energy/lb

— 13.5% crude protein

— 0.6% calcium

— 0.5% phosphorus

— Vitamin A, D and E (and selenium if recommended for the area)

— Cobalt iodized salt.

A creep feed may be purchased or it may be mixed at home using home grown grains plus supplements. Supplements are necessary to provide adequate levels of protein, minerals and vitamins.

If creep fed calves have access to feed starting at 6 weeks to 2 months of age, they will consume up to 227 kg (500 lb) of grain mix and may weigh up to 27 kg (60 lb) more at weaning time than noncreep-fed calves. The cost of the feed, equipment and labor compared against the increased value of the heavier calf will determine whether creep feeding will pay.

Weaning Program

It is preferable that the cows are moved away from the sight and sound of their calves at weaning time. This places less stress on the calves than moving them to an unfamiliar location at weaning. The calves can be moved to their new location 2 to 3 weeks after weaning.

Most of the calves sold in Alberta are sold directly off the cow. The majority go through an auction mart and are sold on an individual owner basis. After purchase they are assembled into groups and shipped to feedlots in central and western Canada. Upon arrival at the feedlot the cattle are introduced to dry feed or silage in bunks, and to water from automatic waterers. Processing can be done immediately upon arrival or delayed until the calves are settled in. Processing usually consists of 2 or 3 vaccinations, vitamin A injection, treatment for warble grubs, tagging, branding and when necessary, castrating and dehorning. Performing all or most of these operations at one time increases the stress associated with moving the calf from the farm to the feedlot. Stress related diseases account for more than 75% of feedlot losses.

Systems of preconditioning calves have been developed to ease some of the stress associated with moving calves to feedlots. The term "preconditioning" has been variously misused. Properly done it includes:

1) Castration, dehorning and branding at least three weeks or more before weaning.
2) Completing all vaccinations well in advance of weaning.
3) Treating with a systemic grub control product (for warbles and lice). In some areas it may be desirable to deworm calves at this time.
4) Holding calves for a period of 3 to 4 weeks after weaning until they are accustomed to dry feed before offering them for sale.
5) Some producers may also elect to creep feed for at least a month or so before weaning.

With these items done 3 to 6 weeks before weaning, the only stress calves will be subjected to at weaning time will be separation from their mothers.

The practice of preconditioning calves began in the early 1960s in Iowa. The program was largely due to the efforts of Dr. John Herricks. By 1969, the first year of a state wide program, 61,000 calves were enrolled. By 1979 there were 400,000 calves in the program. Several other states have started similar programs. A preconditioning program was started in Alberta in 1980. It is called the "Alberta Certified Preconditioned Feeder Program".

Under the Alberta Certified Preconditioned Feeder Program calves must be owned by the producer at least 60 days prior to certification and be at least 4 months old before vaccination. The program allows for either a preimmunization program or a full preconditioning program. Calves are dehorned and castrated where these operations have not been previously performed. Vaccinations include blackleg, infectious bovine rhinotracheitis (IBR) and para-influenza-3 (PI_3 or shipping fever) at least 3 weeks prior to certification. Calves on the full preconditioning program are weaned at least 30 days prior to certification. Calves meeting the above requirements are tagged with different colored tags indicating either preimmunization or preconditioning. Certificates signed by a veterinarian accompany the calves to sale.

The program will only be successful if both the calf producer and the feedlot operator benefit. There is general agreement that preconditioning reduces the incidence of shipping fever and chronic pneumonia. What is debated is whether the producer can recover the extra costs involved in preconditioning.

Cow-calf producers could benefit in the following ways:

- Weaned calves should be able to gain 0.68 to .91 kg (1.5 to 2.0 lb) per day on a hay-grain ration or silage-grain ration to sale date.
- Weaned calves should shrink less in transit to sale.
- Net sale price for preconditioned and preimmunized calves should be higher.
- Producers using these programs should be able to develop a reputation for good calves.
- Cows from which calves are weaned earlier have a chance to get into better condition before winter which should lower winter feed requirements.
- Where calves are weaned earlier than has been customary, pastures should have an increased carrying capacity for dry cows.

The feedlot operator should derive the following benefits:

- Knowing the history of the calf, the operator should be able to do a better job of managing him.
- Reduced vaccination costs since these have been looked after by the producer.
- Preconditioned calves should begin to eat and drink earlier on arrival and should therefore begin to gain weight sooner.
- Both preconditioned and preimmunized calves should require fewer treatments. Relapses and deaths from respiratory diseases should be reduced.

Developing Replacement Heifers

The key to producing top quality fertile cows involves proper management of the cow from the time she is a calf. To produce the maximum number of calves in her lifetime, a cow must calve each year, starting as a two year old.

Table 12 indicated that first-calf heifers are slower to return to estrus following calving and, therefore, should be bred to calve 20 to 30 days before the older cows in the herd. If heifers are to calve at this time, they must be bred by 14 months of age.

Puberty

Puberty is the age at which a heifer shows first estrus. This is the period in a heifer's life when she becomes capable of reproducing and can occur between 7 and 14 months of age. The age and weight at which a heifer reaches puberty is influenced by several factors including level of nutrition, breed, growth rate and heterosis (cross-breeding effect). There is a marked difference in age at puberty among breeds (Table 16). The British breeds tend to reach puberty earlier than cattle such as the Brahman, which has zebu blood. Some of the exotic breeds generally reach a higher body weight and greater age before reaching puberty.

The U.S. Meat Animal Research Centre is studying age and weight of heifers at puberty as one aspect of their breed comparison studies. The results of these studies indicate that crossbred heifers of the exotic breeds should be at least 14 months of age in order to have a higher percentage of the heifers cycling when the breeding season begins. In addition, they should be in the 340 to 352 kg (750 to 775 lb) range for weight when breeding commences. British breed heifers should be a minimum of 14 months of age and 318 kg (700 lb) in weight at the start of the breeding season.

Inadequate levels of nutrition will result in a low percentage of heifers showing estrus at breeding time. This can result in 50% of the heifers being open at the end of the breeding season. Development of heifers to attain reproductive efficiency can be accomplished by feeding supplemental grain with the roughage ration (see nutrition section for grain-roughage combinations). If replacement heifers are not gaining .57 to .68 kg (1.25 lb to 1.5 lb) per day from weaning to start of breedng season the amount of grain in the ration should be increased until they do gain at this rate.

Table 16

Post Weaning Growth and Puberty [A]

Breed of Sire	% Reaching Puberty at 15 Months	Average Age at Puberty (Days)	Average Weight at Puberty	
			kg	lb
Hereford	96	375[B]	272	600
Angus	97	353	254	560
Hereford x Angus	97	377	268	590
Brown Swiss	97	347	277	611
Brahman	80 - 95	400 - 412[C]	320 - 325	706 - 716
Charolais	96	399	294 - 305	648 - 673
Chianina	60 - 85	398 - 455	318 - 342	702 - 755
Devon	98	385	276	609
Gelbvieh	95 - 99	341 - 365	282 - 285	622 - 628
Holstein	99	369	274	604
Jersey	92	328 - 368	221 - 278	487 - 613
Limousin	92	399 - 402	292 - 301	644 - 664
Maine Anjou	99	371 - 402	302 - 305	665 - 672
Pinzgauer	96	309	284	626
Red Poll	95 - 100	360 - 368	264 - 274	581 - 605
Simmental	95	369 - 375	288	636
South Devon	87 - 95	365 - 382	273 - 281	602 - 619
Tarentaise	100	326	284	626

A Composite from 1970 - 1976 calf crops
B 375 days = 12.3 months
C 412 days = 13.6 months
Source: U.S.D.A. Clay Centre 1973 - 77 Reports

In order to successfully breed heifers at 14 to 15 months of age, the following minimum weights should be attained:

Table 17

Recommended Minimum Weights at First Breeding

	kilograms	pounds
Hereford	318	700
Angus	295	650
Angus x Hereford	318	700
Charolais & Charolais x British	340	750
Limousin & Limousin x British	340	750
Simmental & Simmental x British	340	750

Two Year Old Heifers

The first lactation is probably the most critical time in a cow's life. The two year old heifer needs feed for both growth and milk production on top of that required for maintenance. It is very important to make sure she gets enough. It is doubly important for heifers from breeds with milking strain backgrounds. The only time it would not be necessary to supply these heifers with more feed than the rest of the herd would be the years when spring pastures are exceptionally good. If virgin heifers are bred to drop their first calf early in the season (as recommended) pastures are that much more likely to be short for the first two months or so after calving. Special arrangements should be made to supply first calf heifers with extra feed during this period.

Breeding Yearling Heifers

As has previously been discussed, replacement heifers should have been born early in the calving season and should have been fed to gain .57 to .68 kg (1.25 lb to 1.5 lb) per day from weaning to the start of the breeding season. Providing sufficient feed has been emphasized. The other side of the coin is overfeeding resulting in excessive fatness at the time of puberty. This tends to cause fat cells to displace milk tissue which can permanently damage the heifer's potential for milk production.

All of the heifers are not going to cycle so 50% more heifers than will be needed should be turned out to breed. By limiting these heifers to a 45 day breeding season, early calves are guaranteed the next spring. This provides the necessary opportunity for the first calf heifer to have sufficient time to prepare for rebreeding with the main herd.

If more replacement heifers are in calf than are required to replace culled cows the heifers themselves can be culled on the basis of their preweaning test records. (See discussion on R.O.P. in this section.)

Selection of Bulls for Heifers

Normally a young bull should be used on heifers. This reduces risk of injury to the heifers at time of breeding as the heifer must support less weight than if she were bred by a mature bull.

Calving difficulties with heifers are caused by both the sire and the heifer herself. To minimize calving difficulties, a bull should be selected that comes from a sire with a record for easy calving; was born unassisted, preferably with a light birth weight; or is quite fine boned. If an older bull is used, he should have a record for easy calving.

It is more important to select an easy calving bull within the chosen breed than to select a breed for easy calving. In general, British breed sires cause fewer calving problems than many of the larger European breeds.

Selection and Reproductive Management of the Bull

Introduction

The importance of the herd bull in beef production is often not fully appreciated. The bull or bulls selected to head up your herd can represent a large investment and influence the economic returns from the herd for several years. The herd bull not only determines the number of calves born, but also affects the duration of the calving period, calving ease, growth rate of the calves and eventually the genetic merit of the herd as determined by the herd replacements.

When selecting a herd bull, a breeder is generally looking for a high quality individual which, based on pedigree, performance or progeny information, indicates an ability to pass on these desirable qualities to his offspring. In addition, the bull must be able to sire a large number of calves during a short breeding season and be able to maintain a sound physical and healthy condition for a number of breeding seasons.

An understanding of functional reproductive physiology and management is important in selecting and maintaining a fertile bull battery.

The age at which a bull reaches sexual maturity or puberty will vary widely between and within breeds. Most bulls will reach puberty at 10 to 14 months of age although it is common for a bull to have the desire and ability to mate as young as 7 months of age. As puberty approaches, there will be a change in body conformation, an increase in aggressiveness and sexual desire and rapid growth of the penis and testes.

The British breeds will generally reach puberty earlier than the larger exotic breeds. The nutritional status of the bull can also affect puberty as underfeeding results in delayed puberty. While puberty is generally reached at a year of age, it should be remembered that bulls do not reach their maximum reproductive capacity until 3 - 4 years of age. It is for this reason that yearling and two-year old bulls should not be overused and should be kept on a proper plane of nutrition.

Bull Selection

A balance between production and reproduction should be maintained when selecting a herd bull. The following factors should be kept in mind when evaluating a potential herd sire for your breeding program:

- genetic merit
- physical condition and health
- breeding soundness.

Genetic Merit

The genetic merit of a bull can be estimated from his performance and progeny. His performance should be at least equal to the herd average in which he was produced or to the average of a group of bulls on test. Only traits which are medium to high in heritability and are economically important should receive major consideration in your breeding and selection program. Do not get carried away on small, non-economic points, such as breed character or color, which contribute little to productive efficiency or carcass quality.

Physical Condition and Health

The modern type bull should have an ample amount of bone, adequate skeletal size as indicated by height and body length, better than average muscling and a trim brisket and underline. This, in addition to the performance and pedigree of the bull, will be the only data considered by most beefmen. However, a bull with superior genetic potential cannot transmit this superiority unless his feet and legs are sound and he is able to seek out and breed cows in heat.

Young bulls such as yearlings and two year olds seldom have serious feet and leg abnormalities. At this age, sickle or straight hocks or overgrown hoofs should not be tolerated although we do not know how seriously they will affect walking and servicing capacity later in life. Any bulls showing arthritis should be culled without further consideration.

Transmissible diseases should always be of concern when selecting and bringing new bulls into your herd. Bulls should be purchased only from herds and sales with high health standards. Bulls should be examined and tested by a veterinarian previous to purchase and kept isolated from the rest of the herd for at least 30 days after purchase.

Breeding Soundness

A number of surveys conducted in Canada, the United States and Australia have indicated that 10 to 20% of the bulls examined for breeding soundness were sterile or had reduced fertility. With the high cost of purchasing and maintaining bulls, beefmen can no longer afford to compensate for this by running extra bulls in multi-sire breeding pastures.

At the present time, there is no accurate way to predict that a bull will settle 100% or 50% of the cows exposed to him. However, through a breeding soundness examination prior to the breeding season, bulls of questionable or unsatisfactory breeding potential can be eliminated. This procedure will improve the chance of having an early, short calving period resulting in a greater number of heavier calves at weaning.

Many beef operators and bull sales now carry out some type of routine breeding soundness examination. Such an evaluation gives some assurance that the bulls used for breeding will settle a high percentage of fertile cows and helps determine the potential status of bulls offered for sale.

A breeding soundness examination should evaluate a bull's:

- testicular and scrotal development
- semen quality and
- servicing capacity (libido).

Testicular and Scrotal Development

The testicles should be shaped like a football, be equal in size and hang uniformly between the rear legs in the scrotum. The testicles are raised and lowered by muscles in the wall of the scrotum and the spermatic cord to maintain a constant temperature for proper sperm development. Testicular growth is very rapid during the period of 6 to 14 months of age. Bulls should be fed well during this period as a low level of nutrition will result in slow testicle growth and small testicles at maturity.

The testicles have two primary functions; to produce sperm and to produce testosterone, the male sex hormone. Research has shown that testicle size, as measured by scrotal circumference, is closely related to sperm production. In other words, bulls with large testicles can be successfully mated to more cows than bulls with small testicles. A number of studies have also indicated that the bull's age and weight have a great effect on testicular development and size up to puberty. While the relationship between testicle size and semen production is not as great after reaching puberty, larger bulls within a breed will generally have larger testis than small bulls.

The scrotal circumference (SC) of a bull can be easily and accurately measured using a commercially available flexible cloth or metal tape. After restraining the bull in a head gate, the testicles should be gently grasped at the neck of the scrotum. The testicles can then be pulled firmly down into the base of the scrotum by encircling its neck between the thumb and finger and pulling down on the testicles. The scrotal tape is formed into a loop, slipped over the scrotum and pulled snugly around the greatest diameter of the scrotum for a reading.

The breed, age, weight and fleshing of the bull must be taken into consideration when using the scrotal measurement as an estimate of semen producing ability. Table 18 indicates scrotal circumferences for common beef breeds found in Western Canada.

Table 18
Scrotal Circumference of Yearling Beef Bulls

Breed	No. of Bulls	Average Scrotal Circumference (cm)
Aberdeen Angus	162	35.9
Blonde d'Aquitaine	43	33.9
Charolais	473	34.7
Hereford	663	34.8
Limousin	158	32.1
Maine Anjou	189	35.8
Shorthorn	102	34.5
Simmental	194	38.2

(Source — Coulter 1980)

Several breeders, breed associations, veterinarians and researchers have established minimum scrotal measurements which a bull must meet for the breeding soundness examination. Yearling bulls with a scrotal circumference of 32 - 33 cm or greater generally have good semen quality and a good fertility rating. While this is a good guide, it should be remembered that this measurement is by no means a guarantee of a fertile bull. The circumference below which a bull should be culled is not well established, although yearlings and two-year olds with less than 30 cm will likely be subfertile. If used for breeding a very low conception rate and a very lengthy calving period would result.

Semen Quality

The quality of semen produced by the testicles is very important. A high percentage calf crop is dependent to a large degree on using males capable of producing semen of high fertility. The firmness of the testicles provides an indication of the quality of semen produced. Testicles which are firm when manually palpated for consistency generally produce good quality semen, although an accurate evaluation can only be obtained by examining a semen sample. Testicles which are hard or very soft are suspect, and the breeding soundness examination should definitely include a semen evaluation.

Bulls with poor semen quality as measured by the percent of normal sperm have low first estrus conception rates as indicated by Table 19.

Table 19
Relationship Between Semen Quality and Conception Rate During Natural Mating

% Normal Sperm in Semen	No. of Bulls	Cows Bred	Cows Conceiving	Conception Rate
76 - 95%	27	339	192	57%
60 - 75%	6	90	53	59%
40 - 60%	9	139	55	40%
Less than 40%	9	126	37	29%

(Source — Wiltbank 1958)

Semen quality can be determined by collecting a representative semen sample with an electro-ejaculator or artificial vagina. The semen sample can then be examined and evaluated with the naked eye and microscope for color, volume, concentration, motility and morphology. In order to collect and accurately evaluate a semen sample, only qualified veterinarians and technicians should be used. If a semen sample is unsatisfactory, the bull should not be culled immediately. An injury or sickness can cause temporary infertility in the bull. It takes 6 to 10 weeks from the time sperm begins to develop until mature sperm appear in the ejaculate. A semen evaluation should, therefore, be carried out 6 - 8 weeks prior to the start of the breeding season in case a bull has to be re-evaluated before a decision can be made on his breeding soundness.

Serving Capacity

Having normal testicles and semen quality is of little value to a bull unless he has the desire to seek out cows in estrus and has the ability to mount and mate successfully.

Service capacity is the number of services a bull achieves under natural mating conditions over a period of time (one estrus cycle). A bull generally distributes his services equally over the cows in heat. Because cows serviced two or more times during a heat period have a higher pregnancy rate than those serviced once, the more services a bull can achieve during the breeding season, the more cows will be in calf. A bull's serving capacity during pasture breeding can be accurately predicted by exposing a bull to a number of restrained cows or heifers for a period of up to 40 minutes. The number of services during this period is a good indicator of a bull's servicing capacity under pasture breeding conditions. This test will detect those bulls with high and low libido as well as those with a broken penis or an arthritic condition that interferes with attempts to mount and mate.

Bulls with a high libido or servicing capacity tend to have a much higher first estrus conception rate than low rating bulls, although the difference becomes less significant after the second or third estrus cycle. Table 20 outlines work carried out by Dr. Blockey in Australia on measuring servicing capacity.

Table 20
Serving Capacity of Bulls in a 3-Week Mating Period

Bull No.	Serving Capacity in 3 weeks (No. of Services)	No. of Heifers Served
9	105	85
7	96	59
3	93	75
4	47	43
32	46	39
10	44	40
1	38	34
5	26	22
6	20	17
8	16	16
2	13	13
58	2	2

(Source — Blockey)

The number of services carried out during the three week pasture breeding period was very closely related to the serving evaluation placed on the bulls during their initial evaluation using restrained females. The service capacity test will no doubt receive more attention in the future as practical procedures are developed for use by breeders, bull test stations and bull sale organizations. One of the unfortunate concerns regarding service capacity is that it is not necessarily related to fertility. In other words, a bull with good semen quality may have a poor sex drive or vice versa.

Reproductive Management of Bull

Proper care and feeding of the herd sire, especially yearling bulls, is important to ensure optimum breeding performance over a number of years.

Nutrition

As pointed out earlier, proper levels of nutrition are very important especially in the young bull during sexual development. On the other hand, yearling and two year old bulls on a very high plane of nutrition often suffer from temporary sterility and low levels of fertility. It is not known whether such highly fitted bulls recover from this condition although some such bulls placed in AI units for semen collection often recover after a period of time.

Handling Bulls

Under a 90 day pasture breeding season, the following bull to cow ratio can serve as a general guideline:

Table 21

Size or Age of Bull	Cows per Bull
Small yearling	Up to 10
Large yearling	10 - 20
2 year old	20 - 30
3 years and over	30 - 40

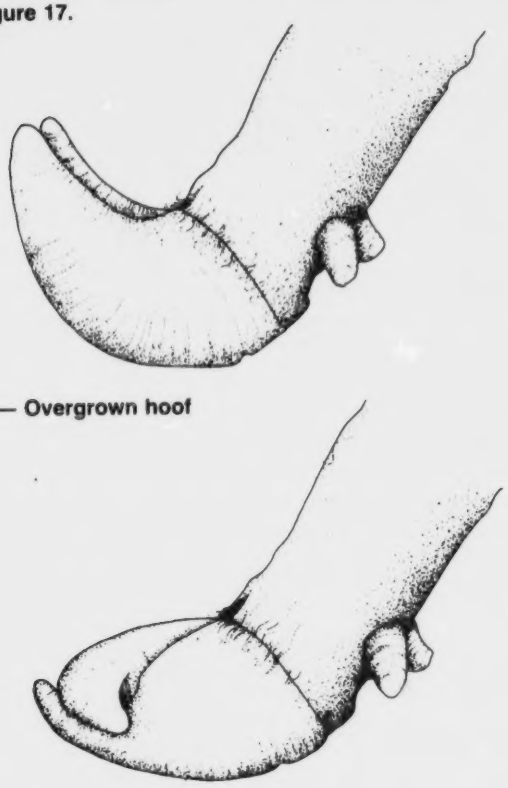
When running multi-sire breeding groups, young bulls should be kept separate from older bulls. Social ranking, generally based on the age of the bulls, can influence the sexual activity in a multi-sire breeding herd. A dominant bull sires more offspring but does not necessarily have the highest sex drive, nor is he always the largest or fastest growing bull in the group.

Where applicable, it is a good idea to give bulls a 3 - 4 day rest every 10 - 14 days, particularly if they are yearlings. Rotation of bulls among pastures is also a good management practice if feasible.

Hoof Trimming

Breeding stock, particularly bulls, frequently suffer from overgrowth of the horny hoof. This extra growth on the hoof makes it difficult for animals to move around in search of pasture and can materially affect a bull's reproductive capacity.

Figure 17.



A — Overgrown hoof

B — Scissor hoof

Hoof trimming is probably most profitably carried out in the spring. Professional hoof trimmers may be employed. Veterinarians are often willing to undertake this work and should be employed for valuable or lame animals. Stockmen can effectively trim feet provided that they are willing to equip themselves with the proper facilities and tools.

Equipment and Facilities

If there are only a few animals requiring attention, the work can be undertaken in a chute. It is infinitely preferable to acquire a portable table.

Hoof shears or double action cutters of various patterns are on the market and solidly constructed equipment is a good investment. A heavy duty rotary sander makes the task easier. Both left and right-handed hoof knives and a sharpening file are important additions to the equipment list. Kopertox dressing and bandages should be available.

Anatomy and Technique

The sole of the hoof is normally concave and the animal bears weight on the outside rim of the hoof. Overgrowth of the horn destroys this arrangement, and after hoof trimming, the outer rim of the hoof should be left slightly longer than the edges next to the cleft. Be careful not to cut the toes off. Try to remove horn from under the toes until the length of the hoof approaches normal. The horn under the heel is normally thicker than at the toe and excessive paring in the heel region may lead to damage of the sensitive structures under the sole.

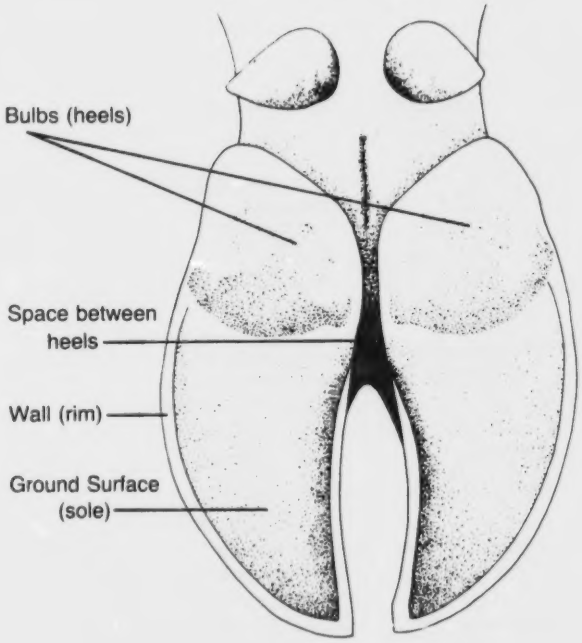


Figure 18. Parts of the hoof

Artificial Insemination

Introduction

Although Artificial Insemination (AI) service has been available to cattlemen in Canada for nearly 40 years, adaptation by the beef industry has been slow. While over 55% of Canadian dairy cattle are bred by AI, less than 5% of our beef cows are serviced this way.

Interest in the European breeds of beef cattle in the early '70s stimulated a marked increase in AI, but a declining beef market and rising production costs have caused a drop in its use. Recent developments in controlled breeding through the use of heat

synchronization makes AI more practical for use in beef herds today.

Advantages of Using Artificial Insemination

1. AI provides the opportunity to utilize bulls of superior genetic producing ability. Most of the beef bulls in AI Studs have been performance tested and many have additional data on the performance of their progency.
2. AI can reduce the threat of venereal disease and lessen the possibility of delayed conception because of sterile sires.
3. The use of AI provides an opportunity to use more than one bull or breed in your breeding program. The problems of rotating bulls and maintaining separate breeding pastures can be minimized by using AI.
4. It is generally less expensive to use AI than to purchase and carry a top quality bull throughout the year.
5. The individual cow and herd records will identify the sire and breeding date which will allow a better evaluation of sire performance and a prediction of calving dates.

Disadvantages of Artificial Insemination

1. An AI program requires more time and skill, especially in the initial phases of the program. A number of factors require additional attention compared to a pasture mating program.
2. Cow identification, handling facilities and breeding pastures must be available.
3. Heat detection should be carried out twice per day on the breeding herd.
4. The level of herd management and nutrition is more critical in an AI program than in a natural service program.

Managing Your AI Program

The success of an AI program requires top level management. Many decisions regarding feeding, facilities, heat detection, sire selection, etc. will be necessary. The use of all available information and the experience gained by other successful users of AI will help the beefman in developing an AI program for his herd.

Identification and Record Keeping

Individual identification of all cows in the herd is essential. Ear tags are the most popular and there are several types available. In addition, neck chain numbers and branding are other excellent means of identification. Whatever method is used, the numbers should be readable from a distance to allow for easy identification during heat detection.

Accurate records are important in an AI program. Calving dates, dates and times of estrus and breeding should be kept on all cows in the herd. The use of a pocket record book and transferring the pertinent information to the herd's permanent records works very well. These records can be used later to evaluate the results of the AI program.

Heat Detection

Detection of heat requires considerable effort and time, but is extremely important to a successful AI breeding program. To master the skill of heat detection, one must understand the behavioral signs a cow exhibits before, during and after estrus. The surest sign of heat or estrus is when a cows stands to be ridden by a bull, another cow or a steer. Cows exhibiting mounting behaviour or other signs of sexual activity may not actually be in heat. However, there are a number of helpful indicators which will assist with heat detection.

A cow in heat will often be restless and may be seen walking the fence line and bawling. She may try to ride other cattle not in heat and may be with a group of sexually active cows which are approaching or going out of heat. Other signs of heat are a moist, swollen and reddened vulva and often a clear mucous discharge from the vagina.

Heat Detection Aids

Several aids have been developed to help with heat detection. These aids can be devices attached to the cows being observed for heat or devices attached to detector animals. The use of pressure sensitive devices such as the KaMar Heatmount Detector may be fixed to the tailhead area of the cow. When the cow comes in heat and is mounted, the pressure sensitive device changes color. However, this marker should be used with caution as pressure from other things besides a mounting animal may also trigger the device.

The use of heat detector animals with chin ball markers to identify cows in heat have become very popular. Gomer bulls (bulls which have been surgically altered by vasectomy, penectomy or those having a surgical deviation of the penis or the insertion of pen-o-blocks in the sheath to prevent mating), or hormone-treated cows or steers equipped with a chin ball marker, roll a strip on the back of a cow when she has been mounted. Again, this heat detection aid must be used with caution as a marker animal may not mount all animals in heat on a particular day or a cow can be marked when not in heat, particularly if the herd is kept in close confinement.

Although heat detection aids can be very helpful, there is no substitute for a skilled person who examines the herd at least twice a day to detect which cows are in heat.

Time of Insemination

The period of standing heat normally lasts 12 to 18 hours. It is during the later part of the heat and the following 6 hours that the cow should be bred. As nearly one quarter of the cows may exhibit heat for 8 hours or less and one-third last 16 hours or more, it is generally recommended that the cows be observed at least twice daily. More cows are generally observed in heat in the early morning than during the evening while a noon observation generally picks up the lowest percent of cows in heat. For best results, cows should be bred in the later stages of heat. A recommended rule of thumb is that cows

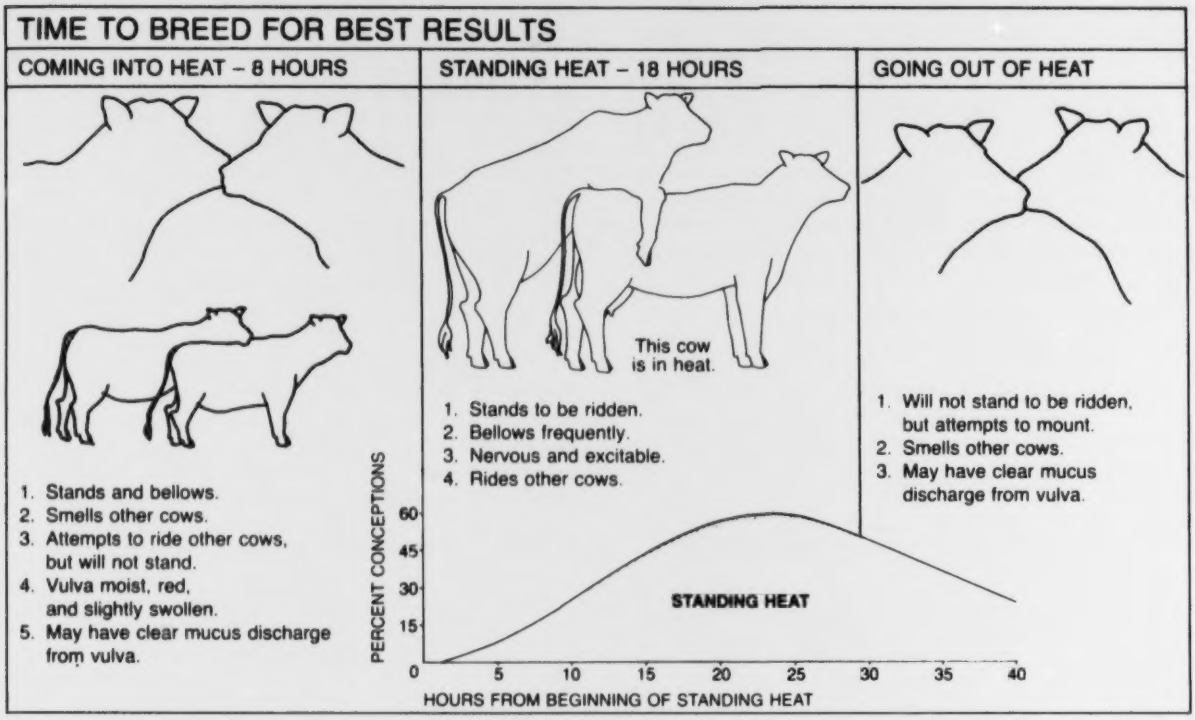


Figure 19. Time to breed for best results

observed in heat in the morning should be bred that same afternoon or evening, while cows observed in heat during the evening should be bred the next morning. Figure 19 outlines in graphic form the indications of heat and when a cow should be bred for the best results.

Factors Affecting Cow Fertility

Cow fertility, an often underestimated problem in a normal breeding program, becomes particularly important in an AI program. One of the reasons it has become a major concern is that with the increasing use of AI records, we are now able to identify low fertility more readily. Cow fertility may be measured by the number of services per conception, days from calving to first heat, breeding season length, pregnancy rate or percent open.

Fertility is closely associated with nutrition both before and after calving, an adequate recovery period from calving to breeding, and freedom from diseases and other abnormalities. Proper nutrition must be furnished 12 months out of every year. Research has conclusively demonstrated that cows on a proper plane of nutrition both before and after calving will come into heat sooner and conceive more readily.

Sire Selection

One of the advantages of using AI is the opportunity it gives of selecting beef sires with superior genetic ability. Some of the best sires in the world are available through your local AI Stud. Top performance and progeny tested sires are available at a very reasonable cost. If you are using AI you should select the kind of bull that is best for you. Information on the performance of a progeny tested bull should include data such as birth weight, weaning weight, ease of calving, post-weaning gain and yearling weight on his offspring. These data along with fertility rating (nonreturn rate) should be used in selecting the sire or sires to be used in the AI breeding program. Sire selection is just as important when using AI as it is in natural service. Remember that all bulls available through AI are not necessarily genetically superior for the traits in which you are interested.

Semen Quality and Handling

The principal sources of semen and supplies are the various AI Studs and artificial insemination businesses in Alberta. While individual breeders may offer semen for sale, a sample dose should be checked at an AI Stud or Alberta Department of Agriculture semen evaluation lab before it is used. Semen must be of top quality with proper storage and handling if desired results are to be obtained.

If the herd is to be bred by someone else, make sure he/she is a reputable technician. If the herd owner is breeding the herd, he should make sure that he has semen and supplies on hand well in advance of the first breeding date. Semen is available in various sized vials and straws, so the recommendations of the semen producing business should be explicitly followed in the thawing and handling of the semen.

Breeding Pasture and Facilities

The breeding herd should be placed in a small level pasture which is relatively free of trees and gullies so that cows can be easily observed for heat. The pasture should

supply ample feed and water for the duration of the AI program. If feed and water supply are a problem, fewer cows should be placed on the program or supplemental feed can be supplied. In fact a 10-12 day synchronized program can work quite successfully under feedlot or winter feeding conditions.

Proper handling facilities are often overlooked in an AI breeding program. A well-designed cattle handling facility can cut out the frustration often associated with inseminating cattle. Keeping excitement and stress to a minimum will pay dividends in a higher conception rate.

The holding pens and breeding chute should be built as close as possible to the breeding pastures. When it is time to inseminate, the cattle should be moved as gently as possible preferably into a shaded area where they can be held and bred without exposure to the hot sun or rainy conditions. A roof over the chute and breeding area will protect the inseminator and the semen from adverse conditions. The breeding chute and corrals should be used for breeding only and should not be used for any other management activity where the cows have been under stress.

Elaborate facilities are not necessary, but if a large number of cows are going to be bred year after year, particularly if they are being synchronized, then a substantial investment is warranted.

The AI facilities should consist of a sorting alley, holding pens and a breeding chute. Cattle tend to follow a curved path more easily then a straight one. With a curved chute, cattle cannot see the AI chute until they are practically in it. If a large beef herd is on a synchronized estrus program, then consideration should be given to several AI chutes.

Many cattle breeders have found that the best way to keep cattle calm and easy to handle during insemination is to use a dark box chute which does not have a head gate. The cow being inseminated is held in a totally enclosed dark chute with the top, side and front gate completely solid with the exception of a small 15 × 30 mm window in the front of the gate. This window helps entice the cow to enter the dark chute. The dark chute (Figure 20) is simple to build and can be modified to accommodate various sized animals. Plans for beef cattle corrals and breeding chutes are available from your local district agriculturist.

Controlled Breeding Program

The recent availability of prostaglandins has made estrus synchronization possible in the beef herd. An injection of the hormone like substance enables the beefman to

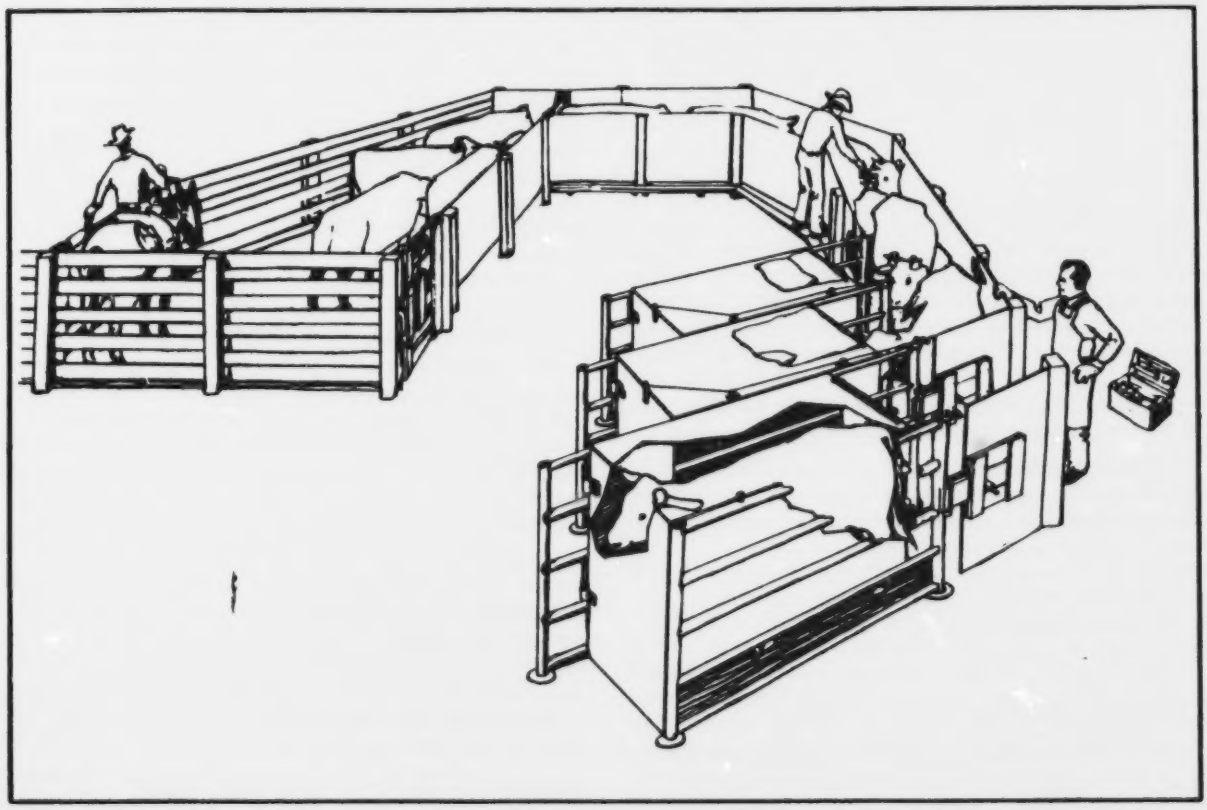


Figure 20. Herringbone AI breeding chute

control the estrus cycle of the cow so she can be bred at a specific time by AI. On a herd basis, a large percentage of the cows can be synchronized to come into heat during a short period of time and can be inseminated during a single insemination period. This procedure eliminates the need for daily heat detection over the usual 3 to 6 week AI breeding period and allows for the efficient use of labor during the injection and insemination of the herd.

Various controlled breeding programs are available to meet the different breeding and management systems found on beef farms and ranches. The factors necessary for a successful AI program are even more important under a controlled breeding program. The progam must be well coordinated so that only normally cycling cows are selected and a qualified AI technician is available to inseminate the herd at the optimum time.

Clean up Bulls

One of the important decisions for an AI beef breeding program is the length of the breeding season and the use of clean-up bulls. Under most AI breeding programs, it is impractical to breed by AI alone or to expect all cows to settle to their first service. The amount of feed available in the breeding pasture and the amount of labor available for heat detection will often determine the length of the AI breeding program.

While a 4 to 6 week AI breeding program was popular in the past, the trend on most ranches today is for the 10-12 day synchronized or 20 day (1 heat cycle) program.

A timed insemination program (2 injections of prostaglandin) should result in a 50-60% conception rate while the 10-12 day synchronization program or the 21 day breeding program where cows are bred after heat detection should result in a 65 to 80% conception rate. An expected conception rate of 50% will require one clean-up bull for each 50 cows while a 65% rate will require one bull for each 75 cows.

Summary

The guidelines for a successful AI program:

1. Plan your breeding program well in advance
2. Identify all cows and keep reproduction records on the herd.
3. Make sure the cow herd has an adequate level of nutrition both before and after calving.
4. Heat detect twice each day.
5. Obtain AI technician service and bull semen from a reputable insemination business.
6. Develop good handling facilities.

COW-CALF NUTRITION

The cost of feed is a major part of the total cost of production in a cow-calf operation. This cost often goes unnoticed in the summer when animals are out on pasture. In the winter, however, feed costs become quite obvious. Even home-grown feeds have specific costs of production attributable to them. Therefore, the winter feeding period, with its increased costs, will generally be of more concern than the summer period.

The winter months are also important because they make up most of the gestation period for the herd. Proper feeding during the gestation period and between calving and breeding are essential for good reproductive performance and calf productivity.

This section will focus on the winter feeding period as it is generally more critical than the summer. Some comments will be made about the supplementation needs of cattle on pasture. This does not mean that proper nutrition can be ignored in the summer months. Inadequate nutrition at any time of year can result in lowered reproductive performance in the herd, immediately or at a later date. This lowered performance will be reflected in the number of calves born and the interval between calvings.

The producer must provide enough feed during the winter season to meet his herd's requirements without providing too much which will raise his cost of production. The best way to solve this dilemma is to supply the animals with a balanced ration that will give them sufficient nutrients in the proper proportions to promote optimum efficiency in performance and costs.

Nutrients

Adequate nutrition means providing the animal with specific levels of the nutrients required for maintenance, production and reproduction. These should supply the animal with: energy, protein, minerals, vitamins and water.

These nutrients are found in varying amounts in all feedstuffs. Table 22 is a listing of some of the feeds that are commonly used in cow-calf operations in Alberta, along with the nutrient levels contained in them. It must be noted that the values listed are *average* values. Few feeds will contain exactly these levels of nutrients, so rations calculated using these levels will only be *approximations*. Specific nutrient levels for particular feeds being used can be obtained by sending samples to the Alberta Agricultural Soil and Feed Testing Laboratory (ASFTL) for analysis.

Table 22

Average Nutrient Content of Commonly Used Alberta Feeds

	Moisture (%)	Estimated Digestible (Mcal/kg)	Energy (Mcal/lb)	Acid Detergent Fibre (%)	Protein (%)	Calcium %	Phos. %
Hay							
Alfalfa	11.0	2.60	1.18	34.5	16.9	1.65	0.21
Clover	11.3	2.53	1.15	45.4	13.0	1.18	0.19
Alfalfa-grass	10.8	2.42	1.10	38.2	13.1	1.12	0.19
Brome	9.8	2.24	1.02	38.4	8.8	0.43	0.15
Timothy	9.4	2.18	0.99	40.0	7.6	0.43	0.15
Native	9.1	2.13	0.97	40.2	8.0	0.44	0.13
Greenfeed							
Mixed Cereal	13.0	2.64	1.20	35.1	9.3	0.32	0.23
Barley	12.6	2.64	1.20	34.3	10.0	0.35	0.25
Oats	12.5	2.53	1.15	36.2	8.9	0.28	0.21
Silage							
Mixed Cereal	64.4	2.64	1.20	35.8	9.3	0.39	0.25
Barley	63.1	2.64	1.20	34.6	10.1	0.44	0.27
Oats	66.2	2.53	1.15	37.2	9.2	0.35	0.23
Corn	70.3	2.86	1.30	31.3	9.4	0.37	0.22
Alfalfa-grass	60.3	2.42	1.10	40.8	13.8	1.32	0.21
Grass (unspecified)	62.8	2.16	0.98	40.7	11.6	0.84	0.22
Legume-grass	66.5	2.31	1.05	44.1	12.8	1.12	0.21
Straw							
Barley	9.0	2.05	0.93	46.3	4.6	0.31	0.10
Oats	10.1	2.16	0.98	45.9	4.3	0.24	0.10
Wheat	8.9	1.80	0.82	49.6	4.0	0.21	0.08
Grains							
Barley	12.0	3.65	1.66		12.1	0.05	0.39
Oats	10.7	3.34	1.52		11.3	0.07	0.35
Wheat	12.3	3.87	1.76		15.6	0.04	0.40
Supplements							
Canola Meal	10.0	3.04	1.38		41.1	0.75	1.52
Soybean Meal (48%)	11.0	3.56	1.62		54.0	0.36	0.75
Dehy Alfalfa	8.0	2.68	1.22	31.5	18.5	1.52	0.22
32% Supplement	10.0	2.68	1.22	15.6	35.6	3.33 – 7.20	0.67 – 1.33
Urea					281.0		

Note: (1) All values except moisture are reported on a moisture-free basis

(2) Value (as fed) = Value (Moisture-free) $\times \frac{(100 - \%\ \text{Moisture})}{100}$

The level at which each nutrient is required by an animal will depend on whether the animal is being fed for maintenance, maintenance plus production or maintenance plus production plus reproduction. Most nutrients can be fed in excess of requirements, but if any nutrient is present in an inadequate amount, it will limit the performance of

the animal. This "principle of the first limiting nutrient" is illustrated in Figure 21. In this example all but one of the nutrients are supplied in amounts adequate for a daily gain of one kilogram or more. Energy, however, is supplied at a level adequate for a daily gain of approximately 0.5 kilograms. The daily gain which will be achieved by an animal on this ration is about 0.5 kilograms. The performance, therefore, is determined by the "first limiting nutrient".

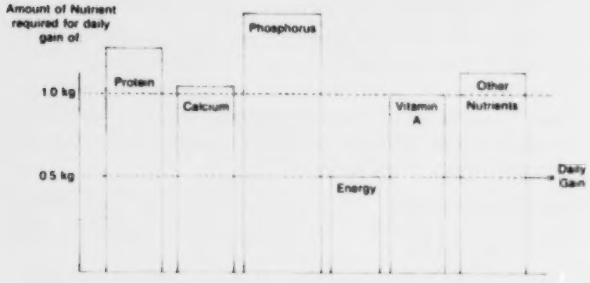


Figure 21.
'Principle of The First Limiting Nutrient'

Energy

Energy is usually the most limiting nutrient in a ration. It is the "fuel" that an animal "burns" for maintenance of body functions, for movement, for heat production in winter and for other productive purposes.

Ruminants obtain energy primarily from the fibre, carbohydrate and fat portions of a ration. Carbohydrates and fibre are fermented in the rumen. During this fermentation, rumen microorganisms increase in numbers and volatile fatty acids (acetic, propionic and butyric) are formed. These volatile fatty acids constitute the major source of energy for the ruminant. This system of digestion is unique to ruminants. Monogastrics (animals with a single stomach) utilize their food without the intervention and assistance of a microbial population.

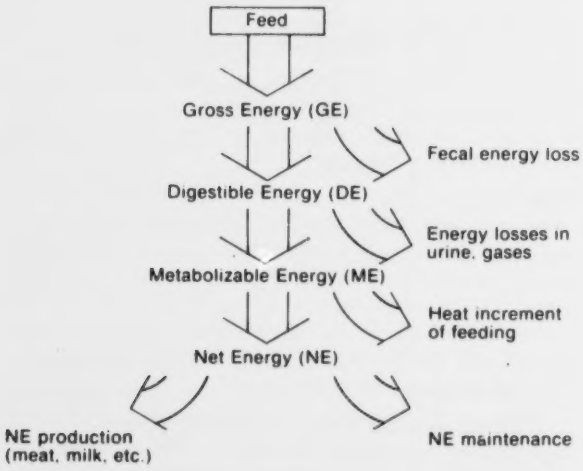


Figure 22.
The partition of energy

The energy content of feed is calculated and expressed in a number of different forms. It is most often calculated for beef cattle as a unit of heat in megacalories (Mcal). The different expressions of energy that exist are: gross or total energy (GE), digestible energy (DE), metabolizable energy (ME) and net energy (NE). The relationships between these different forms are illustrated in Figure 22.

The most commonly used term for energy for ration formulation is DE. This gives us an idea of the actual amount of energy that the animal has available for use. The net energy system of calculation is becoming a popular method for use in ration formulation. However, it was developed under California conditions and does not appear to be completely applicable to Alberta, where more stressful climatic conditions occur.

A deficiency of energy (underfeeding) is the most common nutritional problem in Alberta beef herds. It will cause a reduction or cessation of growth, loss of weight, failure to conceive and increased mortality (often due to a lowered resistance to disease). Energy deficiencies are often complicated by deficiencies of protein or other nutrients.

Wiltbank (1970) demonstrated the effects that an energy deficiency can have on the reproductive performance of the beef cow. He showed that a deficiency in energy before calving can slow down the return of estrus (cows will be slow to show heat after calving) and a deficiency of energy after calving can lower conception rates. His findings are summarized below.

Table 23
Effect of An Energy Deficiency on Reproductive Performance (Wiltbank 1970)

Energy Level		% Which Showed Heat			
Before Calving	After Calving	Days After Calving			% Pregnant from 1st Service
		50	70	90	
High	High	65	90	95	67
Low	High	25	70	85	65
High	Low	76	86	86	42

Another problem, overfeeding, or supplying too much energy, is not only wasteful in that it increases feed costs, but it can also adversely affect reproductive performance by causing calving problems because of increased fat deposition around the reproductive tract which reduces the pelvic area.

The energy value of forage is dependent on species and maturity. As forage becomes more mature the level of fibre increases and the energy content decreases. Voluntary intake of forage also decreases with increased maturity of the forage. When comparing hay which is cut early with hay which is cut late one must remember that the late-cut hay has less energy per kilogram and will be consumed at lower levels. Thus, animals fed poor quality hay on a free-choice basis may not consume enough energy to meet their requirements. Legumes are usually higher in energy than grasses when cut at similar stages. Straws are comparatively high in fibre and low in energy.

Grains are concentrated sources of energy and are thus valuable as energy sources or supplements. Grains vary somewhat in energy content. Bushel weight is a reasonably good criterion with which to compare grains on an energy basis. For example, one kilogram of barley weighing 16 kg (36 lb) per bushel contains about 93% of the digestible energy contained in one kg of barley weighing 22 kg (46 lb) per bushel. The difference in energy on a weight basis might be considered as minimal but the difference on a volume basis would be great.

Protein

Proteins are composed of amino acids which are nitrogen-containing compounds. Muscle, skin, hair, hooves and many other tissues and fluids in the body contain protein.

In the rumen most of the protein in the feed is broken down by the microflora to ammonia and carbon compounds. The microflora then use the ammonia to synthesize their own body protein. As feed is washed out of the rumen into the rest of the digestive tract the microorganisms are washed along too. The ruminant obtains most of its protein by digesting the microorganisms. This process of breakdown and re-synthesis of protein in the rumen allows the ruminant to make use of non-protein nitrogen (NPN) sources such as urea. Such compounds are broken down to ammonia and carbon dioxide (as is whole protein) and used by the microflora to build their own body protein. Assuming there is sufficient energy present in the feed to allow the reactions to take place, ruminants are able to use nonprotein nitrogen sources as efficiently, or nearly as efficiently, as conventional good quality protein such as that in soybean meal.

A portion of the protein fed to the animal passes through the rumen without being degraded to ammonia and carbon compounds. This protein is available for digestion and absorption in the small intestine. This portion of the protein has in recent years commonly been called by-pass protein. Most classes of beef cattle can meet their needs for protein from the microbial protein produced in the rumen, and digested and absorbed in the small intestine. However, cattle with high protein needs such as rapidly growing young calves and superior milk producing cows may require some by-pass protein in addition to the microbial protein in order to meet their protein needs. Most feedstuffs produce some by-pass protein. The amount supplied depends upon the type of feedstuff and physical or chemical treatments that the feedstuff has received.

The primary symptom of a protein deficiency is a depressed appetite. A reduced feed intake can cause an inadequate level of energy intake; therefore, protein deficiencies are often accompanied by energy deficiencies. Symptoms of protein deficiency and the resulting energy deficiency are irregular or delayed estrus (heat) in breeding females, loss of weight, slow growth and reduced milk production.

The levels of protein in roughages decrease as the forage becomes more mature. Green leafy roughages contain more protein than mature roughages; legumes contain higher levels of protein than grasses.

The protein content of grains varies with geographical area, level of nitrogen in the soil and weather conditions.

Minerals

The minerals required by cattle can be divided into two groups:

a) Macro-minerals — those required in fairly large amounts.
b) Micro-minerals or trace minerals — those required in smaller amounts.

There are at least 19 minerals required by ruminants in greater or lesser amounts. Many of these minerals normally occur in sufficient quantities in feeds while others must be supplemented to the ruminant ration in one form or another. The following is a brief summary of most of the minerals required by ruminants.

Macrominerals

Calcium (Ca)

Most of the body's calcium if found in the skeleton. Here calcium forms the bone matrix to allow for the rigidity of the body, protection of soft tissues and attachment for the muscles. Calcium is also needed by the body for blood clotting, nerve and muscle control, acid-base balance and for products such as milk.

Calcium is found in most feeds. Hays, especially legume hays, contain high levels of calcium. Grains, on the other hand, contain very low levels of calcium. Other sources of calcium include mineral supplements such as bonemeal, ground limestone, dicalcium phosphate and defluorinated rock phosphate.

In ruminants, calcium deficiencies are often the result of animals being fed high grain rations without proper calcium supplementation. Deficiencies in calcium will cause rickets in young animals and osteomalacia in mature animals. Rickets is a nutritional disease in which the bones fail to harden properly and, therefore, bend or break easily and cause stiffness in the animal. Osteomalacia is a condition resulting from the withdrawal of calcium from the bones in a period of deficiency which causes bones to break easily and milk production levels to decline. High levels of phosphorus or low levels of Vitamin D may also cause apparent calcium deficiencies.

Calcium is a very important mineral in ruminant nutrition: a calcium supplement should be fed to cattle if grain is the major feedstuff in the ration.

Phosphorus (P)

Phosphorus, like calcium, occurs mainly in the bones of the body. Phosphorus is also used in the metabolism of energy, acid-base balance and in enzyme systems in the body. Relatively high phosphorus levels are found in grains, while levels in roughages are normally lower. Other phosphorus sources are bonemeal, dicalcium phosphate and defluorinated rock phosphate.

A phosphorus deficiency is characterized by poor reproductive performance, as seen by irregular estrus (heat cycle) and reduced fertility. This is reported in Table 24 in research done by Wiltbank and a group of researchers from Texas. A deficiency in phosphorus can also be evidenced by stiffness in the hindquarters, bones

which are easily broken, rickets or pica (a depraved appetite where animals chew and eat rocks, dirt, wood, bones, etc.).

Table 24
Phosphorus Effect on Reproductive Performance Wiltbank (1970)

	No Phosphorus	Bonemeal
No. of Cows	168	168
Calf Crop Weaned (%)	64	88
Average No. of Days Between Calvings	459	365
Texas:		
No. of Cows	40	143
Cows Calving (%)	64	85
Calf Crop Weaned (%)	58	81

In both of these cases, a phosphorus deficiency resulted in a lower percentage of calves weaned and a longer period between calvings.

In a cow-calf operation, where the main feeds are roughages, a phosphorus supplement should be available free-choice at all times to overcome the possibility of a phosphorus deficiency.

Calcium-Phosphorus Ratio

An imbalance in the levels of calcium and phosphorus can be as bad as a deficiency in either of them. Too high a level of phosphorus can tie up the calcium present and cause an apparent deficiency in calcium. Calcium levels which are too high can lower the availability of phosphorus and cause an apparent phosphorus deficiency. For ruminants, the calcium: phosphorus ratio should be not less than 1:1 (equal parts of calcium and phosphorus) nor greater than 7:1 (7 parts of calcium to 1 part of phosphorus). Some recent information suggests that a calcium: phosphorus ratio of 1.75:1 to 2:1 may be necessary for cattle on high grain rations to make the best use of the starch in grain. A low calcium level can cause the pH of the small intestine to be too low for optimum digestion and absorption of starch.

Calcium-Phosphorus Mineral Supplements

The type of mineral supplement to use will depend on the feedstuffs being consumed by the cattle. Cattle on a legume diet should be supplemented with a mineral containing equal amounts of calcium and phosphorus and at least 14% phosphorus. This type of mineral is commonly referred to as 1 to 1 mineral. Minerals containing phosphorus but no calcium can be used with legumes. However, these minerals are generally less palatable than 1 to 1 minerals. If consumption of a mineral containing no calcium is poor, another type of mineral should be used.

Cattle receiving mainly grass pasture, hay or silage should be supplemented with a mineral containing about twice as much calcium as phosphorus and at least 8% phosphorus. A mineral of this type is commonly called a 2 to 1 mineral. However, a 1 to 1 mineral can also be used for cattle on a grass diet. Generally 2 to 1 minerals are more palatable than 1 to 1 minerals.

If cattle are being fed cereal silage or greenfeed, or are grazing stubble aftermath they should receive a 2 to 1 mineral on a free-choice basis.

In general, if grain is the major ingredient in the ration, 1 to 1.5% ground limestone should be added to the grain portion of the diet in order to ensure that the ration contains more calcium than phosphorus.

Cattle on pasture should be able to consume enough mineral supplement if the mineral is supplied in the loose form in a location which is convenient for the cattle. It may be necessary to locate the mineral near the water supply and use salt in locations away from the water supply in order to encourage more uniform consumption of the pasture.

It is important to remember that the amount of phosphorus required by cows increases dramatically after calving. There is a considerable amount of phosphorus in the milk. As a result, the phosphorus requirement of heavier milking cows is much higher than that of average producing cows. Cows that are being fed mainly on roughage will require considerable supplemental phosphorus after calving.

Table 25
Amount of an 18:18 Mineral Recommended to Supplement the Phosphorus Supplied by an Alfalfa-grass Hay Ration for a 500 kg (1100 lb) Cow

	Grams	Ounces
Wintering	15	0.5
Late gestation	15	0.5
Average milker	70	2.5
Superior milker	140	5.0

It is doubtful that cows will consume enough phosphorus on a free-choice basis to meet their needs after calving. It may be necessary to feed some grain with minerals added to cows between calving and the time they go to good green pasture. The energy supplied by the grain will help to meet the cow's increased energy needs at this time as well. If 2.5 kg (5.5 lb) of grain is fed per head per day, include 10 kg (22 lb) of a 1 to 1 mineral in each tonne of grain if average milking cows are being fed. If superior milking cows are being fed add 30 kg (66 lb) of mineral in each tonne of grain. In addition, the mineral should also be available free-choice.

Magnesium (Mg)

Magnesium plays a part in the enzyme systems involved in the transfer of energy and in carbohydrate metabolism.

Normally feeds contain sufficient amounts of magnesium to meet the animal's requirements, but certain conditions can cause a lowered availability of the magnesium. For example, animals which are placed on a lush green pasture may, in some cases, be affected by grass tetany, the most common type of magnesium deficiency.

The condition usually occurs five to ten days after cattle are turned out to pasture. It occurs most often in older cows and in the first two months of lactation.

Symptoms of grass tetany are: unusual alertness and nervousness; muscles twitching; staggering gait, falling; possible convulsions; less acute forms show up as a loss of appetite and a stiffness in gait.

Magnesium supplementation is normally too expensive to use as a safeguard against grass tetany unless this condition has proven to be a severe problem in the past. Grass tetany is caused by a lowered availability of magnesium and not necessarily a dietary deficiency. The precise causes of it are often difficult to ascertain.

Potassium (K)

Potassium, like sodium, serves to maintain proper acidity levels in body fluids and pressure in body cells. It is also required in a number of enzyme reactions in carbohydrate metabolism and protein synthesis. Forages normally contain more than adequate amounts of potassium. Supplemental potassium may be neccessary for high-grain feedlot diets.

Sodium (Na) & Chlorine (Cl)

These minerals are found together as common salt. They function in the acid-base and osmotic pressure balance in the body. Chlorine also forms part of the digestive juices in the abomasum.

There is no reason for a deficiency of salt to occur. Salt is relatively inexpensive and very palatable. Cattle will, in fact, go looking for it if they do not get enough.

Salt should be available, free-choice, at all times.

Trace Minerals

Iodine (I) — Cobalt (Co)

Cobalt and iodine, both trace minerals, are required by ruminants. They are required in very small amounts, but nonetheless are essential in the rations of ruminants. Iodine is used in the control of the metabolic rate of the animal. Cobalt is needed by the rumen microflora to produce the vitamin B_{12} required by the animal.

A deficiency in iodine can cause goiter and the birth of hairless calves. A cobalt deficiency results in a loss of appetite and an anemic, listless, emaciated animal. Animals with a cobalt deficiency show symptoms of starvation, in spite of the fact that feed is plentiful.

Feeds in Alberta are very often deficient in cobalt and iodine. A relatively inexpensive supplement of these minerals is either cobalt-iodized salt (blue salt) or trace mineral salt.

COBALT-IODIZED SALT OR TRACE MINERAL SALT SHOULD BE AVAILABLE FREE-CHOICE AT ALL TIMES.

Salt can be fed either free-choice or as part of the ration. Under ordinary circumstances the use of salt licks or rations containing the usual 0.25% to 0.50% salt will be perfectly safe. If, however, animals are offered loose salt after being without salt for a considerable length of time excessive consumption may occur. Similarly, one should avoid the use of salt-control rations where animals do not have unrestricted access to water.

Excessive salt consumption may cause death by causing an upset in the tissue balance whereby the kidneys are not able to remove excess water from the blood stream. Symptoms include salivation, thirst, muscular spasms, scouring and prostration.

Selenium (Se)

Selenium is deficient in some regions of the province and surplus in others. Alkali disease or blind staggers occurs when cattle eat feed containing toxic or excess amounts of Se (5 parts per million) over a long period of time. Chronic toxicity results in loss of weight, dullness, sloughing of hooves and lameness. Toxicity is rare but occasionally found where cattle on overgrazed pasture in the Brown Soil zone are forced to eat a milkvetch *(Astragalus pectinatus)* that accumulates selenium. The best cure is to remove the animal from the pasture.

Selenium deficiency is much more prevalent and may result in white muscle disease in calves. A vitamin E deficiency increases the amount of selenium required to prevent this form of nutritional muscular dystrophy. Cows on Se deficient diets may have a lower fertility and an increased incidence of retained placentas. The minimum daily requirement of Se is at least 100 parts per billion.

Selenium deficiencies, resulting in white muscle disease, have been observed in many parts of the province. However, based on the results of the feeds tested for selenium at the Alberta Agricultural Soil and Feed Testing Laboratory, and information from producers and industry, we know that selenium deficiency is more of a problem in those areas of Alberta west of Highway 2 or north of Highway 16 than in other parts of the province. If selenium deficiency is a problem supplemental selenium should be used.

If supplemental selenium is required, it can be purchased in complete feeds, salt or minerals. It can also be supplied by injection. When the injectible form is used, injections are needed at monthly intervals.

Iron (Fe)

Iron is an essential part of hemoglobin, a compound which carries oxygen in the blood. A deficiency of iron may cause anemia and reduced growth. There is generally no need to supply extra iron to cattle since virtually all feeds in Alberta contain enough iron for cattle.

Zinc (Zn)

Zinc affects growth rate, reproduction, skeletal development, skin condition and the utilization of protein, carbohydrates and fats in the body. The classical symptom of a severe deficiency is a mange-like skin condition called parakeratosis. While the incidence of this condition is rare in Alberta, the incidence of reduced growth rates as a result of low zinc levels appears to be increasing in the province.

Dietary requirements are about 50 ppm while the average concentration in forage samples analyzed at the Alberta Agricultural Soil and Feed Testing Laboratory (ASFTL) in the past few years is about 20 ppm. If a supplement is required, it can be supplied in trace mineralized salt, or some mineral or protein supplements.

Copper (Cu)

A copper deficiency can result in anemia, depigmentation in hair, rough hair coat, stunted growth, loss of condition, depraved appetite, infertility in cows, diarrhea and cardiac failure. Most of the feeds tested for copper at ASFTL in the past few years contained less than the estimated daily requirement of 10 ppm. The incidence of copper deficiency also appears to be increasing. Copper can be supplemented with trace mineral salts, mineral supplements or protein supplements.

Molybdenum (Mo)

Molybdenum forms an essential part of some enzymes. It may also have a stimulating effect on fibre digesting microorganisms in the rumen.

Excessive quantities of Mo interfere with the utilization of copper and may a cause copper deficiency. Symptoms of copper deficiency include severe scours and loss of body weight. If the diet is high in sulphur the problem is less severe.

The level of molybdenum in Alberta feeds is low. Molybdenum induced copper deficiency does not appear to be a problem in Alberta.

Manganese (Mn)

Manganese is essential for the utilization of carbohydrates. Reproductive disorders in the adult cow are among the early symptoms of a deficiency. These include delayed estrus, reduced fertility, abortions and deformed calves. Calves born to manganese-deficient cows have deformed legs (over-knuckling, enlarged joints, stiffness, and twisted legs), weak and shortened bones and poor growth.

Manganese deficiency occurs occasionally within the province. However, most of the forages analyzed for manganese at ASFTL in recent years contained more than 40 ppm, the minimum requirement.

Other Trace Minerals

Chromium (Cr), tin (Sn) and nickel (Ni) apear to be present in sufficient quantities in the feed to meet the requirements of most farm animals.

Flourine (Fl) is essential for proper bone development but will cause toxicity if fed at too high a rate. It is used in domestic water supplies to reduce the incidence of tooth decay. Too much fluorine causes abnormal bone growth, mottling and degeneration of teeth and delayed growth and reproduction. To avoid excessive consumption of Fl be sure any rock phosphate fed is defluorinated.

When to Supplement with Trace Minerals

There is increasing evidence that some parts of Alberta are experiencing production losses as a result of deficiencies of some trace minerals. These deficiencies are beginning to appear and be recognized on land which has been farmed for many years, especially when high yielding crops are produced, or with livestock where we expect higher levels of production and reproduction than formerly.

Iodine and cobalt have been recognized as deficient in many parts of Alberta for many years. Supplementation through the use of cobalt-iodized salt is recommended routinely. In the past 15 to 20 years selenium deficiency has become a problem in many parts of the province. In areas where deficiency problems exist selenium supplementation should be routine.

Some additional minerals which are now being recognized as deficient on some farms are copper, manganese and zinc. However, before a producer starts supplementing with trace minerals he should be certain that his production problem is not being caused by a deficiency of major nutritents such as energy and protein. Discuss your problem with your local district agriculturist, livestock specialist, veterinarian or feed company nutritionist. Feed and blood tests can be used to detect problems. Many feed testing laboratories have the ability to test for these trace minerals. **Do not provide supplementary trace minerals indiscriminately.** Remember that trace minerals are required in very minute amounts and that some trace minerals can be toxic at levels only 10 times higher than the required amounts.

Vitamins

These organic compounds are required in minute amounts by the body. They are essential to metabolism and some must be supplied in the feed of ruminants.

The vitamins normally required by cattle are vitamin A, D and E. The rest of the vitamins (B-vitamins and vitamin K) are produced in sufficient quantities by the rumen microorganisms so that additional supplements are not needed. (Note section on cobalt).

Vitamins A, D and E or their precursors occur naturally in many feeds. In the summer months, when cattle are on fresh pasture, these vitamins are present in sufficient quantities so that synthetic supplements are not required. However, in the winter months it is advisable to use synthetic sources of these vitamins. The synthetic vitamins are relatively inexpensive safeguards against deficiencies. Also the vitamin content in cured feeds may be very low or unavailable for use by the cattle.

Vitamin A

Vitamin A is the most important vitamin in cattle nutrition. It is the only one which normally *must be added* to cattle diets. It is necessary for bone development, sight, and maintenance of healthy epithelial (skin) tissues. A deficiency can cause an increased susceptibility to disease, night blindness and reproductive failure.

Vitamin A may be supplied by green forages which contain carotenoids. Carotenoids are broken down in the body to vitamin A. Thus forages are not analyzed for vitamin A but for carotenoids, which are measured in milligrams per kilogram or pound: mg/kg or mg/lb.

Cattle can convert 1 mg of carotene to 400 international units (IU) of vitamin A, while chickens can convert 1 mg to 1667 IU of vitamin A. Animals on green grass can store vitamin A in the liver and draw on it for 2-3 months.

The average carotene value of alfalfa hay is 54.1 mg/kg (24.6 mg/lb), but the range of vitamin A equivalent values supplied by alfalfa would be expected to vary from 265 IU to 77,880 IU per kg (120 IU to 35,400 IU per lb). Although Alberta forages may contain sufficient carotene to meet all

requirements, it is good insurance to feed vitamin A, since the carotene content of a forage declines in storage. Vitamin A is inexpensive. The dry granular product is the most economical source.

Alternatively, animals may be injected with a 2-3 month supply. It should be injected twice during the winter.

Water soluble vitamin A is sometimes added to the water, however, it is difficult to tell whether the animal is getting its daily or monthly quota this way. Most mineral supplements should not be relied upon to supply vitamin A as they only contain very small amounts.

Vitamin D

Vitamin D is called the sunshine vitamin because ultraviolet light acting on a compound on animal skin changes that compound into vitamin D. Vitamin D is found in sun-cured forages. Animals kept outdoors or fed sun-cured hay do not usually suffer a deficiency, whereas animals kept indoors and fed silage may do so.

Vitamin D is involved in the uptake of Ca and P, so that a vitamin D deficiency resembles a Ca and P deficiency: rickets in the young animal, weak bones in older animals and a decreased growth rate.

Vitamin E

Vitamin E and selenium have similar and interrelated functions in the body. Use supplements containing vitamins D and E in addition to vitamin A. They may not always be necessary but cost little to add.

Water

Water is also an important nutrient in beef cattle nutrition. A restriction in water intake can greatly reduce feed intake. For this reason, water should be available on an *ad libitum* (free-choice) basis at all times.

Water quality is also important to livestock. It should be free from fecal contamination or algal toxins, and contain less than 100 ppm nitrates. A total salts content of not more than 7,000 ppm can be tolerated by young animals, while older cattle will tolerate up to 10,000 ppm.

Requirements

Different groups of livestock have different requirements for all the nutrients. In a cow-calf operation, the levels of the various nutrients required will depend on whether you are feeding for maintenance, maintenance plus production, or maintenance plus reproduction. The first requirement — that of maintenance — is defined as the amount of feed that must be fed to keep an animal at a particular weight without any significant change in body composition. Maintenance requirement is the feed needed to maintain essential body functions such as respiration, heart rate, eating, keeping warm, etc. It also includes the feed needed to replace the nutrients which are excreted daily from the body. Tissues of the body are constantly undergoing breakdown and repair and, therefore, nutrients are required to replace the proteins and minerals lost. The maintenance requirements of an animal must be met first before any production or reproduction can occur. If we picture an animal as a barrel into which we are pouring feed, the relationship among maintenance, production and reproduction can be more easily seen:

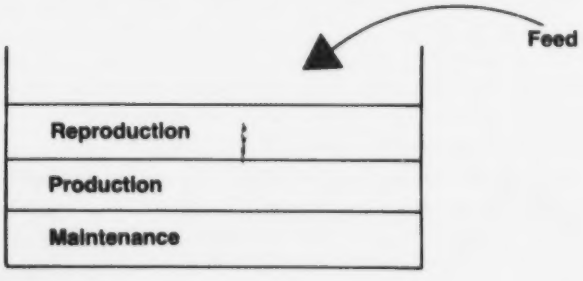


Figure 23.
Relationship between maintenance and production

It is obvious that the bottom of the barrel must be filled first. There are specific maintenance requirements for each of the essential nutrients. Requirements for production are the next ones met. These are the amounts of feed needed for growth or milk production. Large quantities of feed may be needed to meet these requirements. A lactating cow may need about double the energy and protein that a dry cow needs. A growing calf needs much higher concentrations of protein and energy than a mature cow.

The requirements for reproduction are very important in a cow-calf operation. As cows are pregnant for seventy-five percent of the year and this usually occurs during the time of most expensive feed costs, the producer must be very concerned with the requirements for reproduction. These requirements are the amounts of feed needed, above that for maintenance, for the cow to conceive and produce a healthy fetus or calf. They will mean increased requirements for proteins and minerals to build the body of the fetus, plus energy and vitamins to utilize these.

Although requirements for production and reproduction are shown as being separate in the illustration, they can in fact be closely related. Some cows in a herd may reduce milk production and rebreed if the amounts of some nutrients supplied are borderline, while other cows may respond in the opposite way.

The various factors that will determine the level of nutrients required by an animal can be summarized as follows:

- species or breed
- age and sex
- the nature and level of production
- the level at which and chemical form in which a nutrient is fed

- the overall balance of nutrients
- hormonal and physiological activities in the animal
- stresses from the environment.

All factors must be considered when formulating rations for the cow-calf operation. In cow-calf nutrition the object is to formulate balanced rations that supply all the required nutrients at adequate levels, in a proper balance and at minimum cost.

Feed Intake

Beef cattle will consume feed (moisture-free basis) at the rate of 1.4% to 2.7% of their body weight. Feed consumption will vary depending on the ration concentrate-roughage ratio and on the age and condition of the animal. Older and more fleshy cattle will consume less feed per unit of body weight than will younger, leaner animals.

An approximation of the voluntary feed intakes for different types of feeds by cattle is contained in Table 26. The use of these figures, along with some common sense as to practical management, will aid the producer in formulating rations that are within the limit of the physical capability of the animal for feed consumption.

Table 26
Approximate Consumption Estimates of Common Feeds 90% Dry Matter Basis

Feedstuff	Estimated Average Daily Consumption Percent of Body Weight
Excellent quality hay	3
Very good quality hay	2.5
Medium quality hay	2
Poor hay, oat straw or barley straw	1.5
Wheat straw	1
Silage (air dry basis)	2 - 3
Oats	3
Barley	2.5
Wheat	1.5 - 2

Winter Feeding Programs for Cows and Bred Heifers

The condition of cows going into winter has a major effect on the amount and quality of feed they will need. Cows in thin condition in the fall must gain weight throughout the winter. As a result, they must be fed good quality roughage, or an averge quality roughage and some grain. Cows that are in good condition in early winter need only enough feed to maintain their weight until calving. In this case poor quality hay or good straw can be the major component of the feeding program. If your cows are in good condition in early winter, you can use good quality straw for as much as 75% of the cows' diet for the period up to 6 weeks before calving.

Straw can be fed in conjunction with medium to good quality hay, grain, protein supplement or combinations of these materials. Straw is only slightly lower in energy than average quality hay, but is usually low in protein, minerals and vitamins. As a result, additional quantities of these must be provided. In most cases grain or high quality hay will supply the additional energy needed.

Whenever cows are fed on low quality diets, such as straw or poor quality hay, or the amount of feed offered is closely controlled, good management of the herd becomes more critical. In these situations it is very important to know the exact quality of the feeds being used. Feed testing and proper application of the feed test results becomes increasingly important.

It is often beneficial to divide the cow herd into two or three different groups for winter feeding. The first group should be the young mature cows in good condition. These need the least amount of care to get them through the winter in good condition.

The second group should include heifers calving for the first or second time in the spring to follow. These are young growing animals that cannot compete effectively for feed with the mature cows unless all the cows are considerably overfed. They also need either a better quality hay or more supplemental grain than mature cows.

The third group should be made up of thin and old cows. Again, these are cattle which have trouble competing with the more aggressive mature cows in better condition. These cows also need additional feed to get them through the winter. If your cows cannot be handled in three groups, combine the heifers and the old thin cows in one group. It might be wise to send some of the old thin cows to slaughter.

Most winter feeding programs for cows require supplemental minerals and salt. Cobalt iodized (blue) salt or trace mineralized salt should be available on a free-choice basis. In addition, rations based largely on hay should be supplemented by having a mineral supplement containing equal parts of calcium and phosphorus available on a free-choice basis. Rations based on greenfeed, cereal silage or straw and grain should be supplemented, on a free-choice basis, with a mineral containing two parts of calcium and one part of phosphorus. The amount of mineral consumed should be 15 to 30 grams (0.5 to 1 oz) per head per day. It may be necessary to mix salt with the minerals in order to get the cows to consume enough.

A beef cow requires 40,000 IU of vitamin A daily before calving. After she calves, but before she has access to green grass, she needs 60,000 to 70,000 IU of vitamin A daily. The higher amount is needed by superior milking cows. Vitamin A is stored in the liver and is utilized when needed. It can be fed daily, at 2 or 3 week intervals, at 1 or 2 month intervals, or a sufficient supply can be injected every 2 or 3 months. The important thing to remember is that enough vitamin A must be supplied to meet the cow's daily requirement. If the cow is given vitamin A once a month, she must receive a 30 day supply at that time.

The sample rations which follow are designed to meet the needs of a 500kg (1100 lb) mature pregnant beef cow gaining .25 kg (.55 lb) per day under normal winter conditions in Alberta.

The following rations are based on the average nutrient content of Alberta feeds. These rations should contain adequate amounts of energy and protein, but will require mineral and vitamin supplementation. An analysis of your feeds is recommended so you can accurately adapt these rations to your situation.

Ration No. 1
10 kg (22 lb) grass hay

Ration No. 2
9 kg (19.8 lb) alfalfa-brome hay (50:50)

Ration No. 3
6 kg (13.2 lb) good quality barley or oat straw
3.6 kg (7.9 lb) good quality alfalfa

Ration No. 4
7.5 kg (16.5 lb) good quality barley or oat straw
1.5 kg (3.3 lb) oats or barley grain
0.5 kg (1.1 lb) 32% protein supplement

Ration No. 5
4 kg (8.8 lb) grass hay
4 kg (8.8 lb) good quality barley or oat straw
1.5 kg (3.3 lb) oats or barley grain

Ration No. 6
8.5 kg (18.7 lb) good quality greenfeed

Ration No. 7
22 kg (48 lb) cereal silage (65% moisture)

These rations do not make allowance for wastage by cows. The amount of feed offered your cows should be increased to make up for the amount of feed they waste. Although these rations make some allowance for cold weather, under very cold conditions additional feed will be needed to meet the cows' needs for energy. For every 10°C that the mid-day temperature is below – 20°C an additional 3 kg (6.6 lb) of hay, 6.2 kg (13.7 lb) of silage or 2 kg (4.4 lb) of grain should be fed depending on the type of ration being used.

The thin and old cows in the herd will likely weigh 50 kg (110 lb) to 100 kg (220 lb) less than the young mature cows in good condition. As a result these cows will have a lower maintenance requirement in normal winter conditions. This means that if the thin and old cows receive the same amount of feed or slightly more feed than the cows in good condition, the thin cows should gain sufficient weight to bring them through the winter in good condition.

The bred heifers will have about the same per head per day requirement for nutrients as the young mature cows. However, since they are smaller than mature cows, they cannot consume as much feed. They should be able to consume the quantity of alfalfa-grass hay, greenfeed or cereal silage suggested for mature cows. For the straw-grain diets an additional 1.5 kg. (3.3 lb) of grain should be fed. Straw consumption is likely to decrease by about 2.5 kg (5.5 lb). Another possible ration would be 7 kg (15.4 lb) of grass hay and 2 kg (4.4 lb) of grain.

During the last six weeks to two months before calving the amount of nutrients supplied should be increased by about 15%. This can be accomplished either by feeding more of the wintering ration or by substituting some good quality feed for some of the low quality feeds being used in the ration.

Post-Calving Feeding of Cows

After calving the cows' needs for nutrients increase substantially. The requirements of superior milking cows increase more than that of average milking cows. Superior milking cows require about 60% more energy, 115% more protein and 85% more phosphorus after calving than they required in the middle of winter. If the cows requirements are not met they may take longer to begin cycling, have weak or irregular estrus signs, have lower conception levels, and as a result may either not conceive or may conceive late in the breeding season. (see comments earlier in this section under "nutrients"). Depending on when the cows are calving, they are normally fed stored feeds for all or part of the time between calving and rebreeding. This is the most critical time of the year for cows and often is a time of the year when their needs are neglected. Proper feeding at this time of the year will pay dividends in the next calving season. The best quality feeds should be saved for this time of the year.

The following rations will meet the energy and protein needs of 500 kg (1100 lb) cow producing 5 kg (11 lb) of milk. These rations do not make allowance for wastage.

Ration No. 1
10 kg (22 lb) grass hay
1.8 kg (4 lb) oats or barley grain

Ration No. 2
12 kg (26.4 lb) alfalfa-brome hay (50:50)

Ration No. 3
11 kg (24.2 lb) good quality alfalfa hay

Ration No. 4
27 kg (60 lb) cereal silage (65% moisture)

Ration No. 5
7 kg (15.4 lb) good quality oats or barley straw
3.2 kg (7.0 lb) oats or barley grain
1.0 kg (2.2 lb) 32% supplement

The following rations will meet the energy and protein needs of 500 kg (1100 lb) cow producing 10 kg (22 lb) of milk. Again, no allowance has been made for wastage.

Ration No. 1
10 kg (22 lb) grass hay
2.8 kg (6.2 lb) oats or barley grain
0.7 kg (1.5 lb) 32% supplement

Ration No. 2
12 kg (26.4 lb) alfalfa-brome hay (50:50)
1.5 kg (3.3 lb) oats or barley grain

Ration No. 3
13.5 kg (29.7 lb) alfalfa hay

Ration No. 4
27 kg (60 lb) cereal silage (65% moisture)
1 kg (2.2 lb) oats or barley grain
0.8 kg (1.8 lb) 32% supplement

After calving, the cow's requirement for supplemental minerals increases to 60 to 150 grams (2 to 5 oz) per cow per day depending on the amount of milk the cow is producing and the type of feed being used. After calving a mineral supplement containing equal parts of calcium and phosphorus is normally the most suitable. If cows are being fed grain at this time, the mineral should be mixed with the grain as cows usually will not consume a

sufficiently high amount of mineral free-choice. (See details earlier in this section.)

In addition, either trace mineral salt or cobalt-iodized (blue) salt should be fed on a free-choice basis. The vitamin A requirement has now increased to 60,000 to 70,000 IU per head per day.

Winter Feeding Programs For Replacement Heifer Calves

In order to be big enough to breed, the heifers will have to weigh 315 kg (693 lb) to 350 kg (770 lb) at 14 to 15 months of age, depending somewhat on their breeding. This means that the heifers will have to gain at the rate of about 0.70 kg (1.5 lb) per day throughout the winter. The rations for this rate of gain and the comments regarding mineral, salt and vitamin A in the section about growing calves also apply to replacement heifer calves.

Winter Feeding Programs for Growing Calves

In the past producers have used feeding programs designed to allow calves to gain at a rate of .50 to .80 kg (1.10 to 1.75 lb) per day. This sort of program is still appropriate for calves going back on grass the next summer, or for calves which must be grown-out before going on full feed in order that they reach acceptable slaughter weights before getting too fat.

Some producers now aim for a daily gain of .90 to 1.0 kg (2.0 to 2.2 lb). Large growthy calves, especially cross-bred calves from European breeds, have the ability to gain weight rapidly and still obtain acceptable slaughter weights while grading A1 or A2. If you are feeding British breeds of calves as bulls for slaughter, you should aim for a high rate of gain.

A feeding program which produces rapid gains should only be used when the calves are going to remain in the feedlot until they go to slaughter. If the calves are to be marketed as feeder cattle, consider a program which will produce moderate gains, as most buyers of feeder cattle discount fleshy cattle.

Compensatory gains on grass are higher for calves fed to gain 0.5 kg (1.1 lb) /day during the winter than for calves whose winter gain is higher. Calves going to grass in the spring should be fed to gain only a modest amount of weight.

When deciding on your feeding program bear in mind that feed costs per kilogram or pound of gain generally decrease as the rate of gain increases. Check this by applying your feed costs to some of the rations given in the examples which follow.

If you are operating on borrowed money, consider the cost of interest. If you borrowed $450 per calf purchased and your interest rate was 15% per annum, the daily amount of interest on each calf would be about 18.5 cents. This cost is constant whether the calves gain 0, .50 or 1.0 kg per day, and is a substantial additional cost that must be taken into account.

The probable selling price of your calves should also be considered in setting up your feeding program. Information on the market situation can be obtained from Alberta Agriculture, the Canadian Cattlemen's Association, the Alberta Cattle Commission, agribusiness and numerous other sources. If your feeding program needs to be modified to fit in with a change in expected selling date, the earlier you begin the better.

Some grain must be included in most rations for wintering calves. A protein supplement may be necessary if you are feeding poor to medium quality forage. Use the best quality forage available for calves; cows can maintain themselves on poor to medium quality roughage.

Vitamin A should be included in the calves' grain mix or injected every 2 or 3 months. Calves should receive 20,000 to 30,000 IU of vitamin A per day. The lower amount should be used for light calves and for feeding programs that aim for modest weight gains; use the higher level when rapid weight gains are expected, especially from heavy calves. Provided that the total amount of vitamin A meets the daily requirements it can be fed daily, weekly, monthly or injected once every 2 or 3 months.

Most calf rations require mineral supplementation. Whenever possible the minerals should be mixed in the grain portion of the ration. Minerals should also be offered free-choice. If you are feeding a considerable amount of legume forage, use a mineral supplement containing equal parts of calcium and phosphorus.

A ration based on a grass hay, greenfeed or cereal silage should be supplemented with a mineral containing two parts of calcium to one part of phosphorus. Any program using grain as two-thirds or more of the total ration should have 1% ground limestone added to the grain mix. Cobalt-iodized (blue) salt or trace mineralized salt should be available free-choice, or added to the grain mix.

Sample Rations for Calves Gaining .70 kg (1.5 lb) /Day

The following sample rations have been calculated on the basis of "average" Alberta feeds and the minimum nutrient requirements to take calves from 200 kg (440 lb) to 300 kg (660 lb) at a rate of .70 kg (1.5 lb) per day. It is assumed that no growth implants or feed additives are being used. Supplemental minerals, salt and vitamin A must be provided.

Ration No. 1
- 6 kg (13.2 lb) good quality alfalfa hay
- 0.7 kg (1.5 lb) barley grain

Ration No. 2
- 5 kg (11 lb) alfalfa-brome hay (50:50)
- 1.6 kg (3.5 lb) barley grain

Ration No. 3
- 5 kg (11 lb) greenfeed
- 0.9 kg (2.0 lb) barley grain
- 0.6 kg (1.32 lb) 32% protein supplement

Ration No. 4
- 12 kg (26.4 lb) cereal silage (65% moisture)
- 1.1 kg (2.4 lb) barley grain
- 0.5 kg (1.1 lb) 32% protein supplement

Sample Rations for Calves Gaining .90 kg (2.0 lb) /Day

The following sample rations have been calculated on the basis of average Alberta feeds and the minimum nutrient requirements to take calves from 200 kg (440 lb) to

350 kg (770 lb) at the rate of .90 kg (2.0 lb) per day. It is assumed that no growth implants or feed additives are used. Supplemental minerals, salt and vitamin A must be provided as required.

Ration No. 1
5.5 kg (12.1 lb) good quality alfalfa hay
2.25 kg (5.0 lb) barley grain

Ration No. 2
5 kg (11 lb) alfalfa-brome hay (50:50)
2.8 kg (6.2 lb) barley grain

Ration No. 3
5 kg (11 lb) oats greenfeed
2.3 kg (5.1 lb) barley grain
0.4 kg (0.9 lb) 32% protein supplement

Ration No. 4
10 kg (22 lb) cereal silage (65% moisture)
3.2 kg (7 lb) barley grain
0.25 kg (0.55 lb) 32% protein supplement

These calculations have been made to supply the calves with the amount of feed they should be receiving at the midpoint of the feeding period. At the start of the feeding period they should be fed about 10 to 15% less, whereas at the end of the feeding period they should be consuming 10 to 15% more. In very cold weather the average daily gain of the calves will probably be somewhat less than the target gain.

If the calves are implanted, average daily gains could be about 10% higher than the target gains. The protein and mineral requirements of these calves should be increased by about 10% relative to the energy content of the ration. As a result, calves being fed ration No. 3 or No. 4 for either of the target gains should receive an additional 0.2 kg (0.44 lb) of 32% protein supplement.

Remember that "average" rations using "average" feeds may not be optimal for your situation. Ideally, rations should be designed for the actual feeds and management system involved.

These sample rations for growing calves illustrate the following points:

- The quality of roughage affects the requirement for supplemental energy and protein.
- Greenfeed and cereal silage are normally relatively low in protein. Most growing rations based on greenfeed or cereal silage require supplemental protein.

Some other points to remember are:

- High quality legume forages, if consumed at adequate levels, can supply adequate energy and protein in the growing ration to achieve gains of about 0.5 kg (1.1 lb) per day without supplemental grain.
- Grass hay is usually relatively low in energy and protein content. As a result it is usually necessary to feed grain and a protein supplement with grass hay.
- Grains that are high in protein will decrease the need for a protein supplement.
- When protein is the most limiting nutrient, a protein supplement is usually a more economical source of protein than is grain.

Winter Feeding Programs for Bulls

The herd bulls are often the most mismanaged animals in the herd. In the winter they are often forgotten and left to fend for themselves. On the other hand, they are sometimes pampered to the stage of becoming overly fat. Neither situation is good. However, overfeeding of bulls can cause more harm than underfeeding. Overfeeding results in reduced libido (sexual drive) and mating ability. This can have disastrous effects on the calf crop. A good rule of thumb is that a mature bull needs about 50% more feed than a mature cow. The requirements of growing bulls are slightly higher than those of mature bulls.

The following rations will meet the energy and protein needs of a 500 kg (1100 lb) bull growing at the rate of 0.7 kg (1.5 lb) per day. No allowance has been made for wastage in these rations.

Ration No. 1
9 kg (19.8 lb) grass hay
4.8 kg (10.6 lb) oats or barley grain

Ration No. 2
10 kg (22 lb) alfalfa-brome hay (50:50)
3.7 kg (8.1 lb) oats or barley grain

Ration No. 3
9 kg (19.8 lb) good quality greenfeed
4 kg (8.8 lb) oats or barley grain

Ration No. 4
22 kg (48.4 lb) cereal silage (65% moisture)
4 kg (8.8 lb) oats or barley grain

Rations number 1 and 2 do not require supplemental calcium or phosphorus. However, the grain fed in ration 3 or 4 should have 1% ground limestone added to ensure that the ration provides more calcium than phosphorus.

The following rations will meet, without allowance for wastage, the energy and protein needs of an 800 kg (1760 lb) mature bull.

Ration No. 1
14 kg (30.8 lb) grass hay

Ration No. 2
13 kg (28.6 lb) alfalfa-brome hay (50:50)

Ration No. 3
9 kg (19.8 lb) good quality oats or barley straw
5 kg (11 lb) good quality alfalfa

Ration No. 4
10 kg (22 lb) good quality oats or barley straw
2 kg (4.4 lb) oats or barley grain
1 kg (2.2 lb) 32% protein supplement

Ration No. 5
12.5 kg (27.5 lb) good quality greenfeed

Ration No. 6
30 kg (66 lb) cereal silage (65% moisture)

In addition, mature bulls should have access to a 1:1 mineral on a free-choice basis.

Both growing and mature bulls should receive either a trace mineralized or cobalt-iodized (blue) salt on a free-choice basis. They also require at least 50,000 IU of vitamin A per head per day.

Table 27
Minimum Daily Nutrient Requirements of Several Classes of Beef Cattle

Class of Animal	Weight (kg)	Weight (lb)	Expected Daily Gain (kg)	Expected Daily Gain (lb)	Estimated* Feed Intake (90% Dry Matter Basis) (kg)	Estimated* Feed Intake (90% Dry Matter Basis) (lb)	Digestible Energy (Mcal)	Crude Protein (kg)	Crude Protein (lb)	Calcium (g)	Calcium (lb)	Phosphorus (g)	Phosphorus (lb)	Vitamin A (IU)
Growing Steer or Heifer	225	495	.45	1.00	5.9	13	12.7	.58	1.27	17	.038	14	.030	20,000
Growing Steer or Heifer	225	495	.70	1.54	6.4	14	15.1	.65	1.42	18	.040	15	.032	20,000
Finishing Steer	365	803	1.25	2.75	10.0	22	29.8	.94	2.06	31	.068	23	.050	40,000
Finishing Steer	450	990	1.10	2.42	11.4	25	33.2	1.01	2.22	37	.081	27	.060	40,000
Bred Heifer	425	935	.40	.88	9.1	20	19.8	.76	1.67	31	.068	23	.050	40,000
Wintering Pregnant Cow	500	1100	.23	.50	10.0	22	19.2	.59	1.30	20	.045	17	.037	40,000
Late Gestation Cow	500	1100	.23	.50	10.9	24	22.1	.68	1.50	21	.047	18	.040	60,000
Nursing Cow (5 kg milk)	500	1100	.20	.44	12.3	27	25.6	.91	2.00	36	.080	30	.067	60,000
Nursing Cow (10 kg milk)	500	1100	.20	.44	15.0	33	30.9	1.27	2.80	59	.130	48	.105	70,000
Growing Bull	500	1100	.70	1.54	12.7	28	32.9	1.07	2.35	27	.060	25	.055	50,000
Mature Bull	800	1760	—	—	14.1	31	28.0	.89	1.96	23	.050	20	.045	50,000

Range and Pasture Nutrition

During the winter considerable emphasis is placed on meeting the nutrient needs of cattle. However, in the summer we generally rely on range or pasture forage to make up essentially the entire diet of cattle. As a result, producers should consider the ability of forages to meet the needs of cows with calves on pasture. Dr. R.J. Raleigh recently reported the results of a grazing study in eastern Oregon. Usually range forages are high in protein and energy during the early part of the grazing season, with a rapid decrease in quality as they go through the growth stages. In the Oregon study, forages in late April and early May had in excess of 18% crude protein and correspondingly high levels of digestible energy. The mineral content of the forages was also generally in good balance. The protein content dropped to 7 or 8% with a corresponding drop in energy and phosphorus as the forage reached the flowering and seed-production stage in late June and early July. By early September, as the plants matured, the protein content had decreased to less than 4%, again with corresponding decreases in energy and phosphorus content. The pattern is the same in Alberta except that our growing season begins from two to six weeks later than in the Oregon study.

Table 28
Average Nutrient Content (Moisture-Free Basis) of Eastern Oregon Forages During the Grazing Season

	Digestible Energy Mcal/kg	Digestible Energy Mcal/lb	Crude Protein (%)	Phosphorus %
May 1	—	—	18.8	0.22
May 15	—	—	17.7	0.20
May 29	2.77	1.26	12.0	0.19
June 12	2.77	1.26	10.6	0.18
June 26	2.73	1.24	8.6	0.17
July 10	2.55	1.16	7.4	0.16
July 24	2.51	1.14	6.3	0.15
Aug. 7	2.24	1.02	5.3	0.14
Aug. 21	2.11	0.96	4.2	0.12
Sept. 4	2.02	0.92	3.3	0.11
Sept. 18	—	—	2.9	0.11

Source: R.J. Raleigh (1980)

These data demonstrate the need for supplemental mineral throughout the grazing season. It also shows that as pasture conditions mature, cattle should respond to supplemental protein.

The cows and calves grazing the pasture in this study did not receive supplemental energy or protein. The calves had average daily gains of about 0.82 kg (1.8 lb) during May and June, 0.59 kg (1.3 lb) during July, less than 0.45 kg (1 lb) during August and almost no gain after September 1.

A similar study at Swift Current by M.R. Kilcher and J.E. Troelsen in 1973 showed the same pattern. The protein content of the forage peaked at nearly 25% in mid-May and had decreased to less than 9% by the end of the trial in mid-August. Similarly DE levels decreased from about 3.16 Mcal per kg (1.44 Mcal per lb) in mid-May to 2.00 Mcal per kg (0.91 Mcal per lb) in mid-August.

In east central Alberta, R.A. Wroe, R.D. Weisenburger and other staff of Alberta Agriculture have been evaluating the carrying capacity of rangeland reseeded to Russian wild-rye (RWR) as compared with native range. This study is being conducted on the Sounding Creek Community Pasture near Oyen. The following information was collected over a four-year period between 1977 and 1980.

Table 29
Average Nutrient Content of Pasture Forage Samples

	Native Range			Russian Wild-Rye		
	Protein (%)	ADF (%) *	Phosphorus (%)	Protein(%)	ADF (%) *	Phosphorus (%)
June 15	10.7	34.8	0.16	10.9	35.0	0.25
July 15	8.0	38.4	0.14	9.1	37.3	0.20
Aug. 15	6.9	38.3	0.11	6.7	40.0	0.14
Sept. 15	5.9	40.5	0.08	5.6	44.6	0.11
Oct. 15	4.6	42.0	0.07	7.1	38.3	0.12

* ADF = Acid Detergent Fibre

As with the Oregon and Saskatchewan work, nutrient value of the pastures deteriorated as the summer progressed. However, as can be expected with RWR, the nutrient content actually improved between mid-September and mid-October. This gives an indication of the value of grasses such as RWR for fall pasture.

The following is a summary of the average daily gain of the cows and calves on each of the pastures.

Table 30
Mean Average Daily Gains of Cows and Calves on Russian Wild-Rye and Native Pastures

	Native Range		Russian Wild-Rye	
	Cows kg (lb)	Calves kg (lb)	Cows kg (lb)	Calves kg (lb)
June 15 to July 15	1.12 (2.47)	0.91 (2.00)	0.18 (0.40)	0.67 (1.47)
July 15 to Aug. 15	0.36 (0.80)	1.15 (2.53)	0.40 (0.87)	1.14 (2.50)
Aug. 15 to Sept. 15	−0.55 (−1.20)	0.88 (1.93)	0.20 (0.43)	0.92 (2.03)
Sept. 15 to Oct. 15	−0.49 (−1.07)	0.35 (0.77)	0.06 (0.13)	0.64 (1.40)
Overall Average	0.11 (0.25)	0.82 (1.81)	0.35 (0.78)	0.84 (1.85)

The cows on the native pasture gained considerable weight in the first month on pasture. However, on the last two months on pasture they lost an average of 62.4 kg (137 lb) per head. Calf performance during the last month on pasture was markedly below the first three months.

The cows and calves on the RWR pasture consistently had poorer first-month performance than those on native range. However, in the last two months on pasture they consistently outperformed the cows on native range. Even with the RWR calf performance was reduced in the last month on pasture.

When pasture quality decreases in late summer and fall options such as supplemental feeding and early weaning should be considered in order to optimize the performance of the cattle herd. These practices will help to increase the weaning weight of calves and assist in bringing cows into winter in better condition.

GENETIC PRINCIPLES, BREEDING SYSTEMS AND BREED EVALUATIONS

Genetic Principles

Introduction

The physical appearance and characteristics of an animal are influenced by its genetic make-up and by the environment in which it has been raised. Since both factors can influence the results, it is important to know which has the greatest influence on the trait in question. Geneticists refer to the degree to which the genetic make-up is expressed regardless of environment as heritability. The higher the heritability the greater the effect of selection. The lower the heritability the greater the effect of environment (management). When planning a breeding program, traits of high (>50%) or moderate (30 - 50%) heritability should be improved by selection. Traits of low (<30%) heritability should be improved by management changes or crossbreeding. The following table lists the heritability of a few of the more common traits.

Table 31
Heritability of Some Traits
Heritability Estimates

Trait	Heritability
Calving interval (Fertility)	10%
Birth weight	40%
Weaning weight	30%
Cow maternal ability	40%
Cow milking ability	30%
Feedlot gain	45%
Pasture gain	30%
Efficiency of gain	40%
Final feedlot weight	60%
Muscling	50%

No two animals are exactly alike. Therefore when measuring any trait you will find a range of values. In a large population this range expresses itself as a bell curve. See Figure 24.

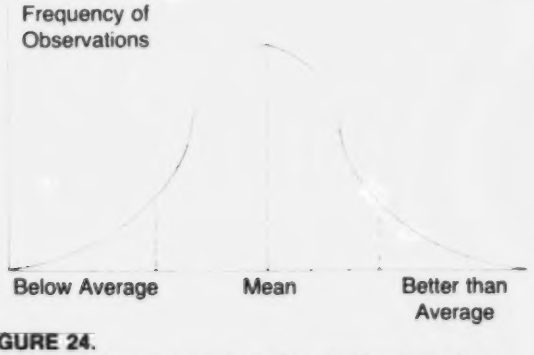


FIGURE 24.
Curve showing distribution of heritable characters

Two-thirds of the population will fall between the dotted lines and not be too far from average. One-sixth will be much worse than average and one-sixth will be much better than average. There is no guarantee that those animals in the extreme one-sixth area are genetically different but the chances are very good that they are. Environment can explain some differences but the further from the mean you go, the greater the probability that the variation is genetically caused. If the breeding objective is to make progress by selection, the fastest results will be obtained by selecting for a trait from amongst the extremes of the population.

Breeding Principles

A sound breeding program should have clearly stated objectives. If it is to be based on a selection program, progress will depend on the following factors:

1) **Number of traits selected** — The more traits selected, the slower the progress made for any one of them. However, the cumulative advantage of selecting for several at once may be greater than the single advantage of selecting only one. Individual experience will dictate which is best.

2) **Selection pressure** — This makes reference to the distribution curve. The greater the difference between the selected animals and the herd average, the faster will be the movement toward the selection objective. Also, if a large proportion of the poor producing animals are replaced by good producing animals each year, progress will be faster than if only a small proportion of the poor producing animals are replaced each year.

3) **Generation interval** — this is the length of time it takes to turn over the breeding herd of both bulls and cows. The faster both cows and bulls are replaced by superior animals the more rapid the genetic improvement will be. This means culling a high percentage of poor producing cows each year and using an individual bull for only one or two years. Both bulls and cows must be replaced by animals superior in the traits selected if progress is to be made. If one selects the cow herd for weaning weight, then buys unknown or untested bulls, little progress in weaning weight due to selection will result.

4) **Heritability** — Heritability is the proportion of the physical variation for any trait which is attributable to the genetic make-up of the animal. The heritability estimate must be determined by research. The more heritable the trait, the more rapid change through selection can be.

5) **Compatability of traits selected** — Some traits tag along with each other and may be beneficial or detrimental to the overall objective. Feed efficiency improves as daily

gain improves. Dam milk production and calf weaning weight move together. Mature size and yearling weight increase together. Unfortunately calf birth weight tags along with mature size, yearling weight and average daily gain on feed. There may be others that are associated. Birth weight increases do not pose a problem until it adversely affects birth ease. Some research has shown that birth weight can be held down while increasing weight gain, but progress is very slow.

Another way to overcome undesirable tag-along traits is to address the problem directly. Since heifers have the greatest incidence of calving difficulty, breed them to a bull with known easy-to-calf progeny. If mature size is a concern, try to breed cows of satisfactory size to large high-gaining bulls. This way the original selection objective can be met through a breeding system. Selection objectives can then be changed to fit the new program.

The main point to be made about trait compatability is that once the tag-along traits start to cause problems, progress in achieving the major trait becomes more difficult as selection against the tag-along slows down improvement in the major trait.

Breeding Systems

There are many different types of breeding systems and each type has variations. For our purposes, we will deal with straight breeding, cross breeding and composite systems. All of these systems can achieve some measure of improvement over no system at all. No one system works best for all people. There are advantages and disadvantages to each which are noted in the following discussion.

Straight Breeding

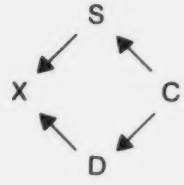
Straight breeding involves breeding cattle of only one breed. The purebred industry uses this system in order to maintain breed purity. It involves breeding cows to bulls of the same breed and making selections on the basis of either performance, type, pedigree or combinations of all three. Three main variations of straight breeding are used.

Inbreeding

Once popular, inbreeding is used less today than formerly. Related animals are mated in the attempt to combine favorable genes in the offspring in the homozygous state. All genes come in pairs. If each gene pair can be made identical (i.e. homozygous) **and** favorable, a better animal should be possible. Unfortunately, undesirable genes are also "fixed" in the homozygous state by inbreeding and cause a deterioration of the vigor of the offspring. Culling of poor animals must be severe if real gain is to be achieved and most producers find the culling rate too expensive. As inbreeding increases, the health and vigor of the herd decline so productivity of the remaining cattle will be less. Be very certain that the increased "purity" of the breeding herd is worth the cost.

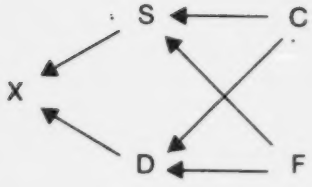
Examples of Inbreeding:

Half-sib matings



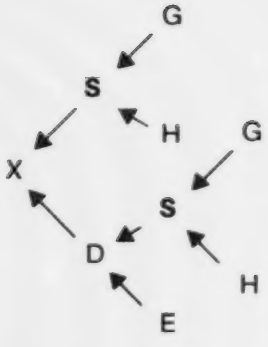
Inbreeding 12.5%

Full-sib matings



Inbreeding 25%

Sire-daughter mating



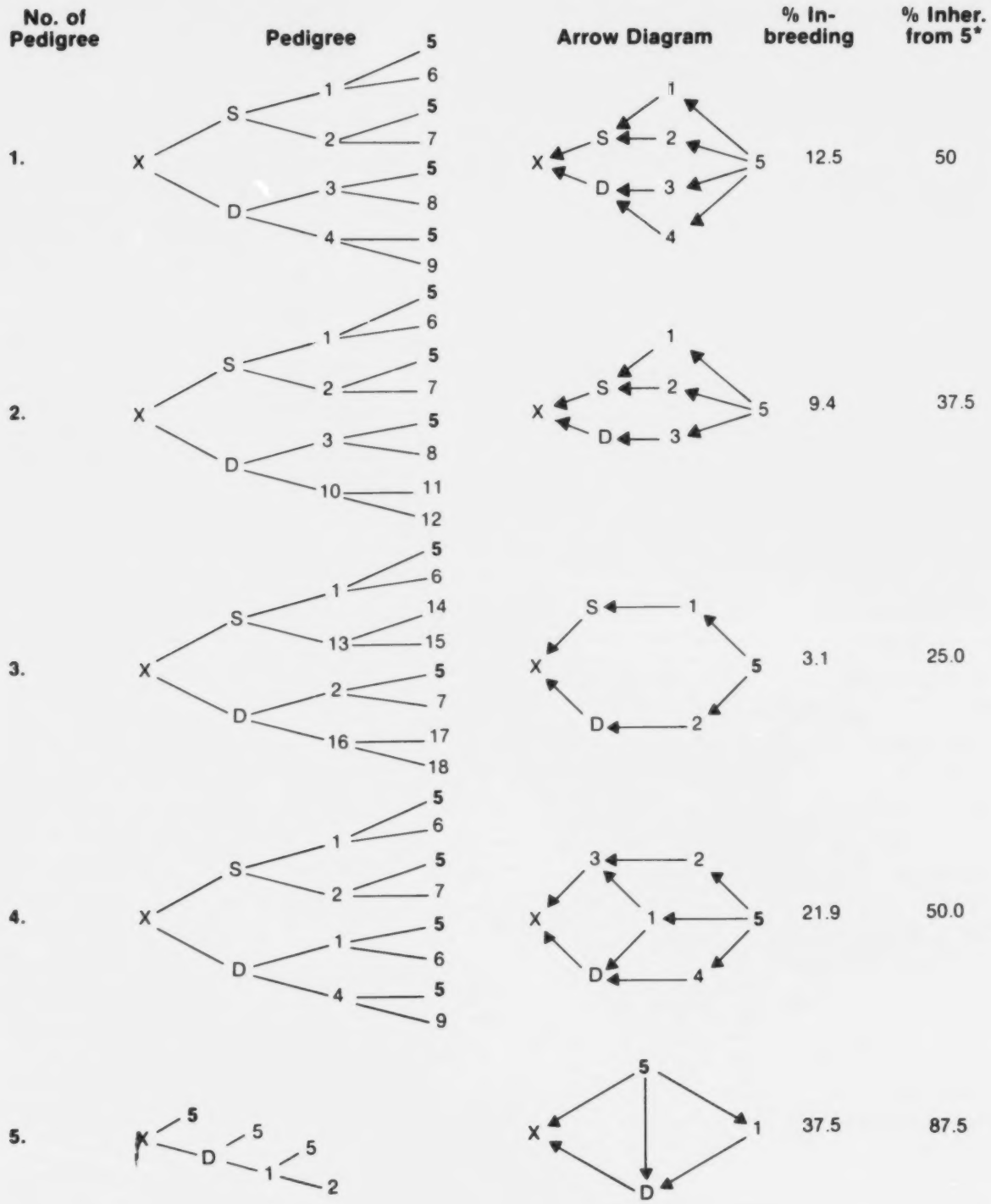
Inbreeding 50%

FIGURE 25.
Examples of Inbreeding

Note: Before starting an inbreeding program be very certain to start with superior breeding stock and maintain a rigorous ROP program for selection and culling.

Linebreeding

This is a mild form of inbreeding. Rather than mate close relatives deliberately, progeny of a special parent are selected to use in the breeding herd. Linebreeding can be easily carried out using semen from a particular bull for a long time in order to increase the number of his progeny in the herd. After his use ceases he is usually followed by one or more of his own male progeny. It is obvious that the longer a sire is used the higher the level of inbreeding. Most practitioners of line breeding remove a sire when sire-daughter matings cannot be avoided. He will then be replaced by a son. It is very important to select replacements carefully on this program because inbreeding will turn up quite a few duds as well as superior offspring. Linebreeding will eventually cease to produce superior offspring and new genetic material should be introduced.



*Probable percent of inheritance received from ancestor 5.

FIGURE 26. Examples of linebreeding: Pedigrees and Arrow Diagrams of the Pedigrees Which Illustrate Some Different Systems of Linebreeding

Modified from GENETICS OF LIVESTOCK IMPROVEMENT
John F. Lasley

Out Breeding

This involves mating animals that are largely unrelated. The main principle is to breed the best stock available. The progeny will show a certain amount of heterosis. A common objective is to select a sire that is strong in a trait in which the cow herd is weak. This form of corrective breeding will not come up with any new genetic material for seed stock herds, but the level of herd production will be better than with either of the above-mentioned programs. It is very suitable for commercial herds that wish to maintain a one-breed identity. It is also ideal for seed stock herd owners who wish to produce for "the middle of the road" cattleman. The sires selected for breeding from herds such as these may not breed as true as inbred cattle, but the increased vigor and expanded gene pool make up for it. A program which uses ROP selection will find progress easier with this system because of the expanded gene pool.

The discussion of the above-mentioned three breeding systems has been very general. A breeding herd may be using variations of all three systems at one time. It should be obvious that the most consistent progress will be made if the breeding results are monitored. The best monitoring system is a performance test program. It should be used both to cull poor cattle and to select replacements. It should also be used when buying replacement sires.

Crossbreeding

Many research studies have demonstrated the advantages of crossbreeding. Many crossbreeding systems have been devised to try to take full advantage of heterosis (hybrid vigor). The three main types of crossbreeding are specific breed crosses, rotational crosses and composite or synthetic breed development. The maximum potential hybrid vigor is obtained when a hybrid female is mated to an unrelated sire. The more unrelated the parents the greater the heterosis.

Heterosis is difficult to explain genetically but the results are easy to understand, that is, we do not know exactly why it works, just that it does. The most typical explanation of heterosis is that the production of the hybrid offspring is greater than the average of the parents' production. Using weaning weight as an example, suppose average weaning weight of dam group A to be 204 kg (450 lb); suppose weaning weight of sire group B to be 209 kg (460 lb); the average of the two groups is 206.5 kg (455 lb). The weaning weight of the resulting calves should be 5% higher than the parents average or 217 kg (478 lb).

Striving for heterosis may not always be beneficial. Some breeds may be so much better in a particular trait (e.g. Holstein and fluid milk production) than the other breeds that the resulting crosses are actually lower in production than the best producing parent line. Heterosis is still there because the hybrid cows are better than the average of the two parents though not better than the best parent. When viewed in all traits (i.e. cream, milk solids, reproduction, useful age) the hybrid may be better, but if all the income is generated on one trait, it becomes uneconomical to improve the others at the expense of milk production.

The level of improvement that one can expect in beef cattle from crossbreeding has been examined. In studies done at Lethbridge by Dr. L.J. Sumption, the following effects of crossbreeding on performance within the British breeds were noted:

1) The comparison of performance of crossbred and straightline bred calves produced by straightbred cows showed:
   - 3% more crossbred calves survived to weaning
   - 5% more weaning weight in the crossbred calves
   - 6% more yearling weight in crossbred steers
   - 8% more yearling weight in crossbred heifers
   - crossbred heifers were 10% younger than straightbreds when they showed their first heat cycle.
2) The comparison of performance of crossbred and straightbred cows producing crossbred calves showed:
   - Crossbred cows had a 10% higher conception to first service.
   - Crossbred cows had a 6% higher pregnancy rate at the end of the breeding season.
   - Crossbred cows had 7% more calves at weaning.
   - Crossbred cows produced 6% more weaned weight per calf.
   - Crossbred cows produced 15% more pounds of calf weaned per cow bred.

In summary, the effects of crossbreeding are increased calf survival, higher fertility, earlier maturity and faster growth rates. The three way cross had a better level of performance than the two way cross.

Crossbreeding will necessitate changes in management some of which may be regarded as disadvantageous. Some of these are:

- Most systems require the use of two or three breeding pastures or the use of an artificial insemination program. The use of multiple breeding pastures should be considered when the herd is large enough to use a number of bulls. Crossbreeding can be adopted in small herds through the use of AI and a clean-up bull of a different breed.
- Heavier milking crossbred cows, particularly first calf heifers, require a higher level of management than low milking cows.
- Some crosses require different post-weaning management. The crossbred steers of some of the larger breeds should go straight to the feedlot and be moved to a high energy ration without the use of a "growing out" period. Crossbred heifers of the larger breeds should be fed to be 75 pounds heavier than the British breed heifers at first breeding.
- More effective marketing may be required, particulary when selling feeder cattle.

Specific Systems

These require the same breed or composition of parents for each generation. The biggest concern is the production of replacement females since the offspring are ineligible as replacements for the parent herd. By far the most popular static system is the specific three-way cross using two

maternal oriented breeds to produce the hybrid females and then crossing them with a terminal or meat-type breed. All resulting offspring from this last cross are sold.

FIGURE 27.
Typical 3-way crosses:

Line A	×	Line B	Hybrid female	×	Line C
Hereford		Salers			Charolais
Angus		Tarantaise			Maine-Anjou
Shorthorn		Simmental			Gelbvieh

The operator has the option of buying all his breeding stock or raising his own in separate herds. If he raises his own female replacements, he will need to devote about one-half of the total herd to this aspect of the enterprise. If he wishes to raise the meat sires also, a further ten percent of the cow herd will have to be devoted to this cause. Only 40% of the herd will be left for the terminal cross. Only large herds could undertake such a system because so many breeding pastures are needed unless a full AI program is used. This system makes the most of heterosis, approaching 100% on the terminal cross, if all replacement females are purchased. Its total effect is reduced however, because of the large number of straightbred females required to produce the hybrids.

Rotational Crossing

2-Way Rotation — The simplest such system involves two sire breeds, e.g. Hereford and Angus. The crossbred heifers are kept and are bred to the other sire breed, i.e. the breed other than the one to which their own sire belongs.

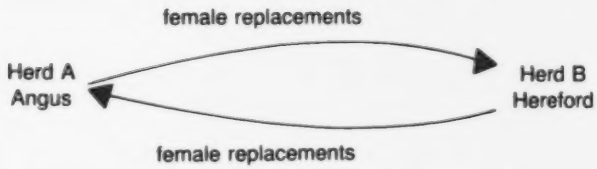


FIGURE 28. A 2-way rotation

This system requires only two breeding pastures and uses hybrid females in all cases. It is capable of utilizing only about 66% of the total possible heterosis.

Selection of breeds is a little more complex than in the static systems, however, because each breed will be both maternal and terminal. The best choice will be breeds that are considred dual purpose. This system works best in herds using two or four bulls. Small herds (one bull herds) may also use a variation of this system by using a bull of one breed for three years and then a bull of the other breed for three years. Heterosis is not as high but it is present and worth the effort.

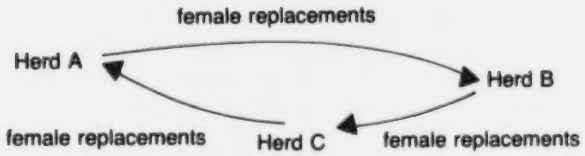


FIGURE 29. 3-way rotation

3-Way Rotation — Three breeding groups are required here and up to 87 percent of total heterosis can be obtained. This system takes optimum advantage of heterosis. Its main disadvantage is in breed selection. Highly specific breed types are not likely the best choice since all types will be used as both maternal and terminal. A producer could use a terminal sire in one of the herds since it will be diluted fairly quickly. The three-way crossing system can be recommended for use in herds requiring three to six bulls.

Over 3 Breed Rotation — Rotation systems using more than three breeds do not gain much in heterosis and only increase the complexity of the breeding system. If you wish to use many breeds try a composite or a rotational composite discussed below.

Rotation-terminal — The major disadvantage of the three-way specific crossing system of having about 50% of the females as straightbred can be removed using this system.

About 40 - 50% of the breeding females are allocated to a two-way rotation system. It would be advisable to select the best maternal type cows for this group. The main purpose of this subherd is to produce productive female replacements. Bulls of breeds noted for maternal characteristics, while being compatible with the overall objective of meat production, should be selected for this herd.

The balance of the breeding herd is used with terminal sires. Replacements for the terminal herd will come from the older or less productive but still useful cows in the rotation group. The bulls can be selected from a meat type breed. Use a breed that will blend with the cow herd and produce beef that meat markets demand while maximizing production.

Other Systems — There are many other systems of crossbreeding for large breeding herds. These will not be discussed here. See the bibliography for fact sheets available from Alberta Agriculture which explain in greater detail how to set up such complex systems. In most cases these programs usually need to be tailored for the specific herd and management conditions of the unit.

Composites

Recent research by the team at Clay Center Nebraska has shown that a mix of breeds in one breeding herd can maintain approximately 85% heterosis while the herd remains closed, i.e. sires and replacement heifers are selected from within the herd. They do recommend that new blood be introduced every few years to offset inbreeding, but in larger herds the heterosis remains relatively high.

One of the breeding herds at the U. of A. ranch at Kinsella is a composite of Charolais, Angus and Galloway with some Brown Swiss and Simmental added more recently. This main herd has shown a consistent superiority to the purebred herd maintained on the same premises after 20 years of breeding and selecting.

The most difficult job in a composite herd is marketing strategy. The color patterns can be quite awesome. If the selection program is good all the cattle will have a good growth rate regardless of which color segregates out, but it can be a little difficult to convince buyers of this unless they are crossbred enthusiasts.

Starting a composite is a bit difficult. If the herd is large, select several sires from the breeds you wish to include and breed a number of females to each. As heifers are selected from these matings, replace the original females. After a few years of preparatory breeding with outside sires, the herd is partially closed and both sires and dams are selected from within the herd. Performance criteria should be the main focus for selection. Some people have tried to stabilize color patterns a bit. This only tends to hold down performance progress.

Which breeds to select is a tough decision. Since the herd is closed it must be a dual purpose herd, that is, it must be both maternal and terminal, unless it is to be a part of a larger program. In this case it might, for example, serve the purpose of a maternal composite to breed to terminal sires. A combination using the British breeds (Hereford, Angus) and some of the dual purpose European breeds (Simmental, Limousin, Salers, Gelbvieh) would be good choices. There are many other breeds which would also work well. First choices will depend on available breeding stock and personal preferences.

Summary

1) Any system of breeding must be flexible. Superior females should be added to the breeding herd even when breeding is different from the planned program.

2) The future genetic improvement of a herd will depend upon how intensively a breeder selects to improve the genetic merit of the herd and on the level of genetic merit within the herds of seed stock suppliers.

3) Select the best bulls possible from the breed of your choice. A poor bull will produce poor calves regardless of whether the calves are crossbred or straightbred.

4) Never base the evaluation of a breed on the basis of the progeny of one bull, as there are wide variations within all breeds.

5) Never base the evaluation of a breed on the basis of a few individuals or progeny of the breed.

6) Management may have to be altered to get maximum results from crossbreeding. One type of crossbred may respond differently to a certain environment than another type of crossbred or a straightbred animal.

Breed Evaluations

There are well over 30 breeds of cattle in Canada from which breeders can choose breeding stock. This is both a great advantage and a problem. The advantage is the ability to almost tailor-make a breeding program. The disadvantage is the difficulty in picking the best breeds for the job. Table 32 lists some of the physical characteristics of the various breeds. This table is only a rough guideline. Breeders have made some major improvements to the breeds imported to Canada over the last 15 years and fairly substantial differences exist even within the various breeds. Therefore there may be several strains within various breeds that are suitable for different tasks.

Table 32
Physical Characteristics of Breeds

Breed	Birth Weight		Mature Weight				Milk Production		
			Cows		Bulls		% Fat	Milk	
	kg	lb	kg	lb	kg	lb		kg	lb
Aberdeen Angus	32	70	522	1150	794	1750	(4.4)	1800	4000
Ayrshire	34	75	522	1150	794	1750	3.9	3900	8600
Blonde d'Aquitaine	50	110	703	1550	1134	2500	3.8	907	2000
								3175	7000
Brown Swiss	36	80	590	1300	930	2050	3.9	3629	8000
Charolais	43	95	794	1750	1089	2400	(4.0)	(1814)	(4000)
Chianina	45	100	907	2000	1270	2800	(4.5)	(1134)	(2500)
Galloway	27	60	454	1000	680	1500	(4.0)	(1588)	(3500)
Gelbvieh	43	95	635	1400	1043	2300	4.1	3175	7000
Guernsey	32	70	499	1100	728	1600	4.5	3402	7500
Hereford	34	75	544	1200	839	1850	4.4	(1588)	(3500)
Highland	30	65	408	900	680	1500	—	—	—
Holstein	41	90	635	1400	1089	2400	3.8	4309	9500
Jersey	27	60	385	850	635	1400	5.0	3175	7000
Limousin	36	80	590	1300	953	2100	4.5	(2268)	(5000)
Lincoln Red	34	75	590	1300	907	2000	3.7	3629	8000
Luing	(34)	(75)	544	1200	953	2100	—	—	—
Maine-Anjou	45	100	907	2000	1247	2750	3.7	2722	6000
Marchigiana	43	95	658	1450	1179	2600	—	—	—
Meuse-Rhine-Ijssel	41	90	635	1400	1089	2400	3.6	4309	9500
Murray Grey	30	65	522	1150	826	1800	(4.4)	(1814)	(4000)
Normandy	(39)	(85)	635	1400	998	2200	4.0	3311	7300
Pinzgauer	43	95	590	1300	907	2000	4.0	3175	7000
Red Angus	32	70	522	1150	794	1750	(4.4)	(1814)	(4000)
Red Poll	34	75	522	1150	726	1600	3.7	3538	78000
Romagnola	45	100	635	1400	1089	2400	—	—	—
Saler	(36)	(80)	590	1300	907	2000	3.7	2585	57000
Shorthorn	34	75	522	1150	794	1750	4.2	(1814)	(4000)
								(3629)	(8000)
Simmental	43	95	748	1650	1089	2400	4.0	1814	4000
								3629	8000
South Devon	36	80	635	1400	953	2100	4.2	2948	6500
Tarentaise	36	80	590	1300	816	1800	3.7	2631	5800
Welsh Black	34	75	522	1150	839	1850	4.0	3175	7000

Evaluations such as the one currently underway at the U.S. Meat Animal Research Center at Clay Center, Nebraska provide needed information on some of the new breeds. The study, which started in 1969, is designed to study a full range of economic traits relating to growth, feed efficiency, reproduction, maternal ability and carcass and meat traits.

Foundation cows used in the study are straightbred Hereford and Angus. About 10 bulls of each of the breeds in the study were used each year. An average of 200 calves from each sire breed were produced in the first year of the study, with comparable numbers in subsequent years.

Cycle I of the study included Hereford, Angus, Jersey, South Devon, Limousin, Simmental and Charolais sires. Starting with the 1973 calf crop a similar evaluaition of the Red Poll, Brown Swiss, Gelbvieh, Maine-Anjou and Chianina breeds was begun at Clay Centre. The study of these breeds has been designed as Cycle II.

Cycle III included the study of Brahman, Sahiwal, Pinzgauer and Tarantaise. All breeds have been compared to the Hereford and Angus as standard.

The data obtained for each breed are primarily from crossbreds. The sires from the breeds tested were bred to Hereford and Angus cows (phase 1) and to crossbred cows (phase 2). At this stage no attempt is being made to evaluate the breeds as purebreds.

The data collected for breed of sire included: calving ease, birth weight, average daily gain to weaning, 200 day adjusted weight, gain on feed, various carcass traits, age at puberty for female progeny, weight at puberty and percent pregnant. A few other minor traits are also measured.

The test is divided into two phases. The first phase described above evaluates the breed as a sire crossed on Angus and Hereford females. The results are compared to Hereford X Angus crosses.

The second phase tests the breed as a crossbred female mated with a third sire breed. The traits measured are all those mentioned above plus average calving interval, percentage pregnant as three-year olds, and weight at 3.5 years amongst others.

The research center issues periodic reports which summarize all the findings to date. No attempt will be made to summarize these findings in this manual because of the sheer size of the report. Provincial livestock specialists have access to these publications or you may obtain your own copy by writing to:

U.S. Meat Animal Research Center
Agricultural Research Service
Clay Center, Nebraska, U.S.A.
68933
Ask for the Germ Plasm Evaluation Program reports.

Various research trials have been carried out by Agriculture Canada Research Stations. See the bibliography for a list of their publications.

The various breed associations also collect research reports in which their breed has been tested and they can point out the features in which their breed has excelled.

The federal ROP program summarizes progeny results for bulls on ROP and issues an annual report. This is called the sire monitoring program. Provincial livestock specialists, artificial insemination studs and district agriculturists usually have copies on hand or you can obtain copies directly from Agriculture Canada on request. The report details progeny results for each sire used in over five herds with about 50 calves. Calving ease, weaning weight, and gain on feed are the traits reported. This report will not evaluate breeds conclusively, but it does indicate how some bulls of the various breeds are doing.

A breeding program will be most successful if economic traits are the ones selected to gain improvement. Then the best method of improving the traits for which you are selecting should be used. If heritability is high, ROP selection can be used. If heritability is low, a crossbreeding program should be used. Good quality breeding stock from a tested herd will permit much faster improvement than poor quality or untested stock. Finally, keep at it. Progess may be slow at first but once good females begin to replace poor ones, progress will accelerate.

ANIMAL HEALTH

Animal Health

Introduction

The subject of animal health is wide ranging and includes a number of areas. Some of the major areas with which veterinarians are concerned include diseases of animals, nutritional deficiencies, genetics, the influence of housing systems, and plant and other poisons. This section has been included to make producers more aware of the various conditions which will affect their cattle and consequently limit production. The diseases of most economic importance to cow calf production are included. The causes, symptoms, prevention and treatment of the diseases are given. No specific doses of drugs for treatment are given as the doses vary from area to area and with the size and type of animal and the product used. This information may be readily obtained from the local veterinarian.

Disease prevention and proper management are the keys to a successful animal health program. Producers should involve their veterinarian to a greater degree at the preventive level. In the long run this practice is far more profitable than waiting until the disease has become advanced before consulting a veterinarian. Too often, the veterinarian is only called after all else has failed. The chance of his saving an animal under these conditions is usually minimal and if he is not successful the visit is a waste of money.

In recent years, the fixed and variable costs of a beef cow/calf enterprise have increased much more than has the return on investment. This cost-price squeeze is forcing beef producers to seek methods of increasing production and lowering production costs. One of the best methods available to the producer is a preventive herd health program that focuses on the disease and management problems that cause economic loss. The economic loss in a cow-calf enterprise results from three major causes: clinical diseases, subclinical diseases and variations in management that result in failure to achieve optimum production. The overall incidence of disease in beef cattle is low compared to other species of livestock. Available information suggests that, with the exception of newborn calves, only slight economic benefits can be achieved through intensive disease control measures in most beef cow herds. In the area of disease control, the most beneficial role of the veterinarian in programmed animal health is to ensure that preventive and control measures are regularly followed to prevent potentially large losses from outbreaks of disease. The greatest economic gain in most herds can be made by increasing the efficiency of production and it is here that a veterinarian through a herd health program can make a significant contribution.

Herd Health and Management Calendar

1. **Precalving and calving season (early spring).**
   - Identify cows with vaginal prolapses for culling.
   - Watch for abortions and submit aborted fetuses for diagnosis.
   - Check for lice and treat if infested.

- Discuss vaccinating the cow herd for calf scours with a veterinarian.
- Prepare for calving, especially for calving problems.
- Obtain a supply of electrolyte solution and antibiotic preparations for treating scours.
- Inject calves with vitamin E and selenium, and vitamins A, D and E if necessary.
- Watch for calf scours and pneumonia.
- Keep calving areas clean, dry and well bedded.
- Record birth dates and calf birth weights and identify calves.
- Re-assess nutrient requirements and performance of heifers and cows.

2. **Breeding season (spring and early summer)**
   - Check daily for scours and pneumonia in calves.
   - Fertility, evaluate all breeding bulls:
     — semen quality
     — physical examination
     — libido
   - Have your veterinarian examine any breeding females which suffered reproductive problems before turning out for breeding.
   - Assess the bull to female breeding ratios required.
   - If AI is to be used, prepare teaser animals.
   - Vaccinate all replacement heifers for IBR and vibriosis, if necessary, 30 days before breeding.
   - Vaccinate all calves over two months of age for blackleg.
   - Castrate, dehorn and implant calves.
3. **Preweaning and weaning (fall)**
   - Prepare calves for weaning. Preconditioning should include vaccination for blackleg and related diseases and IBR/PI_3. If ITEME is a problem, include hemophilus vaccination.
   - Pregnancy test and cull nonpregnant and poor health risk cows.
   - Vaccinate cows for vibriosis if necessary.
   - Treat for warbles and external parasites.
   - Wean calves with a minimum of stress. Watch calves for pneumonia and treat promptly.
   - Weigh calves and record weaning weights.
   - Make initial selection of heifer and bull replacements.
   - Evaluate performance of the breeding herd by calculating:
     — percent calf crop
     — weaning weights
     — death loss percentage
     — cost per pound of calf marketed.
4. **Wintering period**
   - Take inventory of feeds available and submit for feed analysis.
   - Work out rations for the different classes: pregnant heifers, pregnant cows, heifer replacements, bull replacements, breeding bulls, feeder calves.
   - Initial vaccinations for calf scours vaccines may be given in the fall instead of mid-winter. First calf heifers or problem herds "should receive a booster three to four weeks before calving".
   - Check cows each day for signs of heat and rubbing or scratching because of external parasites.
   - Watch for abortions.
   - Increase your knowledge about the beef business:
     — research and extension publications
     — extension meetings
     — farm press
     — commercial firms and consultants
     — nutrition and management programs.

Table 33

Summary of Vaccination Procedures for the Control of Some Infectious Diseases in Western Canada Beef Herds

Disease	Time to Vaccinate	Remarks
• Infectious bovine rhinotracheitis (IBR) • Para-influenza (PI_3)	At least 3 weeks before weaning, before breeding, or at entry into a feedlot. In feedlots, the vaccine should be given within 24 hours after arrival.	Intranasal safe in pregnant cows. Intramuscular vaccination may cause abortions. If calves are vaccinated at 2 to 4 months of age, they should receive a booster shot when they are 6 to 7 months old.
Clostridial Diseases • Blackleg (*chauvoei*) • Malignant edema (*septicum*) • Infectious hepatitis (*novyi* type B) • Bacillary hemoglobinuria (*novi* type D) • Enterotoxemia (*perfringens* types B, C and D) • Tetanus (*tetani*)	Calves after 2 months of age. Bacteria-vaccines and toxin-vaccines available include: * 2-way bacteria-vaccine, for blackleg and malignant edema * 3-way bacteria-vaccine for blackleg, malignant edema and tetanus * 8-way (contains both bacteria-vaccine and toxin-vaccine) for all those to the left	All beef cattle should be vaccinated for blackleg and malignant edema. The necessity for vaccination for the other clostridial diseases depends on the prevalence of each disease in the particular geographical area. A few cases of infectious hepatitis, bacillary hemoglobinuria, and tetanus have occurred sporadically in Western Canada.
• Bovine virus diarrhea (BVD)	Calves at 6 to 8 months. Breeding females at 1 month before breeding.	Not for pregnant cows. May not be effective for some animals.
• Vibriosis	Vaccinate cows 10 days before breeding season. Vaccinate heifers 50 days and again 10 days before breeding season.	Booster vaccination must be given close to time of breeding to ensure a high degree of immunity during breeding period.
• Hemophilosis	Vaccinate calves 3 weeks prior to weaning and again at weaning.	Initial vaccine given upon entry to the feedlot; booster recommended 21 days later. Recommended more for 5-8 month-old calves.
• Bacterial scours: enteric colibacillosis of calves	Pregnant cows twice: 6 and 2 weeks before calving.	Vaccines are made from strains of *E. coli* bacteria from calves infected with diarrhea in previous year.
• Viral scours: rotavirus diarrhea of calves	Newborn calves immediately after birth.	Use **only** if rotavirus infection has been established in herd. Insufficient field information available to date to make recommendations for general use.

Beef Cattle Diseases

The control of disease and prevention of deaths are important aspects of the management of beef cow herds. In the following discussion of diseases affecting beef cattle, a specific agent or factor is often given as the cause of the disease. It should be realized that any agent may not be solely responsible for the presence of the disease. Environmental, nutritional, genetic or other factors, or a combination of these may aggravate the effect of the agent. Clinical signs of disease are often the result of the interaction of many factors.

The common diseases affecting cow-calf production are presented in this section. The diseases are organized on a calendar basis to follow one complete production cycle of the beef cow herd.

September & October

Blackleg

Cause

Bacteria (*Clostridium chauvoei*)

Transmission

— Soil-borne infection.

— Presumably enters through digestive tract or wound. Usually young stock affected, but all ages can be involved. Organism invades muscle, causing severe inflammation and systemic toxemia.

Signs

— Animals usually not seen alive with the disease but found dead.
— If alive, lameness is characteristic.
— Swelling (hot and painful; later cold and insensitive with gas). Skin becomes dry and cracked.
— Fever, depression marked.

Treatment

Massive doses of antibiotics, but results are not encouraging.

Prevention

Vaccination: response to vaccine is good but immunity requires 10 to 14 days to develop.

Control

— Routine vaccination of all calves between 2 to 6 months of age and revaccinate between 8 and 12 months gives good protection.
— Constant surveillance.
— Movement from affected pasture.
— Isolation of infected animals.
— Proper carcass disposal (spores produced). Deep burial or burning is advised.

Malignant Edema

Cause

Bacteria (*Clostridium septicum* and others).

Transmission

— Soil-borne.
— Enters body through wound.
— All ages of animals can be affected.
— Deep puncture wounds and crushed tissue are ideal sites for infection.
— Surgical wounds.
— Parturition.

Potent toxins are produced in the local lesion and cause death when absorbed into the blood stream (toxemia).

Signs

— Appears 12-48 hours after infection.
— Soft, doughy swelling at site of infection; later skin over site becomes tight.
— Fever.
— Death in 24-48 hours.

Treatment

A massive dose of antibiotics given early in the disease is best.

Prevention

— Routine vaccination program along with blackleg.
— Vaccination two weeks before surgery such as castration, dehorning.

Control

— Movement of herd from affected pasture.
— Vaccination.
— Constant surveillance.
— Isolation of infected animals.
— Proper carcass disposal.

Infectious Bovine Rhinotracheitis (IBR)

The Disease

A viral infection of the upper respiratory tract that affects primarily the internal structures of the nose and the trachea or windpipe.

Cause

Virus belonging to the family Herpes virus. **Note:** The cold sores people sometimes develop when exposed to wind burn or cold are also caused by a virus belonging to Herpes family.

Transmission

Spread in droplets of moisture exhaled from affected animals.

Latency

This virus can exist without causing any signs in an animal. This is called the latent stage. When the animal is put under stress in later life the virus will be reactivated and may be spread to other animals. This is often the only explanation for an outbreak in a herd that has been closed for some time.

Signs

The virus can cause disease in a variety of manifestations. It can occur on a ranch in one form or in several forms.

Abortion Form: Abortions can occur at any time, but they ususally occur in the last third of pregnancy. Abortions occur suddenly and animals do not appear sick. Vaccination before breeding assures control of abortions caused by IBR.

Respiratory Form: Usually damage is restricted to upper respiratory tract e.g., nose, sinuses and windpipe. Signs include a fever, harsh coughing, nasal discharge, watery eyes and loss of appetitie for a few days. Recovery is usually complete in one week. A low percentage of infected animals will develop secondary infections.

Vaccination usually provides good control of respiratory IBR.

Ocular Form: This can occur in any susceptible class of cattle and usually occurs along with the respiratory form. The discharge from the eyes is clear at first then turns white and "mucous-like".

IBR may also appear in the following form:

Genital Form: An inflammation of the reproductive organs of bulls and cows. In bulls the virus produces lesions on the penis which temporarily interfere with breeding. In cows and heifers an inflammation of the vulva is seen which often results in a yellowish-colored discharge for a few days. Recovery usually occurs without treatment.

Diagnosis

The signs described above are only indications of IBR infection. Positive diagnosis requires laboratory investigation of infected tissues — e.g., fetus and placenta. Examination of blood serum for evidence of increased levels of antibodies is helpful.

Treatment

The IBR virus is not affected by antibiotics. However, control of secondary infections is often valuable.

Control

Control is based on both vaccination and management.

Vaccination:

When vaccinating beef breeding herds for the first time, vaccinate all females (heifers and cows) with either the intramuscular or intranasal vaccine one month before breeding and no later than two weeks before breeding. **Do not vaccinate pregnant females with intramuscular vaccine.**

— Vaccinate all breeding bulls one month before the breeding season.

— Once all breeding animals have been vaccinated, only the heifers and the bull replacements need be vaccinated on a yearly basis. The immunity obtained from the initial vaccination is usually reinforced through natural exposure to the virus.

— In a preconditioning program, calves should be vaccinated with either the intramuscular or intranasal vaccine three to six weeks before weaning.

— Weaned calves and feeders should not be vaccinated during a period of stress.

— The intranasal vaccine can be used safely in pregnant cattle, and in the face of an outbreak of IBR, all pregnant cattle may be vaccinated. If an outbreak is threatened a few weeks before calving, consult your local veterinarian for vaccination recommendations.

— Some vaccines contain the IBR and PI_3 virus and still others contain the IBR, PI_3 and BVD viruses. These double and triple vaccines must be used with care because complications are possible. Professional veterinary advice should be obtained. The veterinarian will evaluate the disease history in the herd and make his recommendations based on the expected incidence of disease in that herd.

— Both the intramuscular and intranasal IBR vaccines will provide some protection against the respiratory form of IBR in feeder cattle, but the degree of protection is variable. The IBR vaccines **will not** provide protection against all of the other common diseases of the respiratory tract of cattle such as shipping fever, pneumonia (Pasturella pneumonia), viral pneumonia, necrotic laryngitis and atypical interstitial pneumonia (Pulmonary emphysema).

— It is not possible to make uniform vaccination recommendations which can be applied in any cattle herd. The recommendations made by a veterinarian will vary from one herd to another and from one area to another depending on the particular circumstances.

Some of these circumstances include:
— time of year problem is present
— origin of cattle if purchased
— the disease history of the herd
— the vaccination history of the herd
— the kind of cattle which are being threatened on the farm at the present time.

Note: Cattle breeders selling purebred stock internationally should be aware that some countries require imported cattle to be negative to any IBR blood test.

Control by vaccination is assisted by management:

— Avoid "topping off" a feedlot pen when there have been some cattle resident in the pen for some time.

— Avoid mixing pens of newly placed cattle with resident cattle in a feedlot. Try to keep "side by side" pens in a feedlot filled with cattle that have been on feed for the same length of time.

Shipping Fever or Pneumonia

Cause

— The stress of weaning or transporting reduces the calf's defence mechanisms.
— Respiratory viruses (of which there are many) may further compromise the calf's ability to defend itself.
— Bacteria (commonly *Pasturella spp*) then are able to get down into the lung in large numbers.

Transmission

— Via respiratory route.
— Occurs when previously pastured calves are confined in a lot.
— Occurs when calves of various origins — e.g., between purchased calves and the owner's weaned calves.

Occurrence

— Occurs with greater frequency in younger, smaller calves (late calves).
— Associated with climatic changes during fall months though it can occur any time.
— May be associated with inadequate nutritional intake post weaning.

Signs

— Initially high temperature.
— Depressed; calves are reluctant to move, with ears down, head down.
— Off feed; may be gaunted up.
— Discharge from nose and coughing.
— Rapid breathing usually.
— Diarrhea in some cases.

Course

— Recover and return to normal.
— Survive but are unthrifty (lung abscesses, adhesions).
— Death.

Treatment

— Good management.
— Antibiotics (Penicillin, Terramycin).
— Sulfas.

Note: Early treatment very important. Treatment should continue for at least three days.

Prevention

— Reduce stress.
— Isolate new animals, constant surveillance.
— Purchase only healthy additions.

Atypical Interstitial Pneumonia (AIP)
(Pulmonary Emphysema, Fog Fever)

A number of specific causes of AIP are known (e.g., mouldy feeds, dust from hay, lung worms). However, in many outbreaks the cause cannot be determined. The disease is often seen shortly after cattle have been moved from dry grazed-down pastures to new pastures in the late summer and fall.

It is thought to be an allergic lung reaction. Recent studies suggest that high levels of tryptophan in the forage cause the disease.

Signs
- Sudden onset one to two weeks after moving.
- Labored breathing often with grunting.
- Mouth breathing and head extended.
- Frothing at mouth.
- Temperature normal or slightly elevated.
- Sometimes sudden death.

Treatment
- Should be commenced as soon as possible.
- Adrenalin.
- Cortisones.
- Avoid excitement.

Prevention and Control
- Remove from pastures.
- Avoid dusty feeds.
- Observe animals closely when moved to new pasture.
- Rumensin may be effective if fed before and after moving to new pastures.

Bovine Viral Diarrhea (BVD, Virus Diarrhea)

The Disease

Virus diarrhea is an infectious disease of cattle and causes both diarrhea and sores on the inside of the mouth.

Occurrence
- The infection is widespread in most cattle herds and exists without any apparent signs of illness.
- The disease appears on a farm and then characteristically disappears in subsequent years.

Seen most often in animals 6 months - 2 years of age.

Transmission
- Ingestion of manure- and urine-contaminated feed.
- Transmission can occur throughout a herd very quickly.

Signs
- Mild form — diarrhea, off feed, fever.
- Severe form — persistent watery diarrhea, sores in salivation, often inflammation of eyes, lameness. Survivors remain unthrifty.
- Fetal form — infection during pregnancy can cause abortion, stillbirths, mummified fetuses and birth defects.

Diagnosis

There are many causes of diarrhea in cattle. If BVD is suspected, veterinary assistance should be sought immediately. Post-mortem examination with laboratory assistance is essential for confirmation.

Treatment

Is usually directed at the control of secondary infections.

Control
- Vaccines are available but their use should be discussed with your veterinarian.
- Application of hygenic principles and isolation of affected animals will limit the spread of infection.

Sleeper Syndrome (Infectious Thromboembolic Meningoencephalitis) (ITEME)

Cause
- Bacteria (*Haemophilus spp.*) This organism may also be involved in other disease process.

Occurrence
- Mostly in feedlots; rarely in pastured animals.
- Usually animals 6 to 10 months of age (spring calves).
- Usually occurs in December, January and February.

Transmission
- Assumed to be respiratory spread.
- Assumed to be carried by mature cows.

Signs
- Muscular weakness and stiffness.
- Usually fevered.
- Incoordination (wobbly walk).
- Paralysis (calves cannot get up).
- Calves usually lie flat on their side prior to death.
- Death usually in 6 to 8 hours.

Diagnosis
- Usually a post-mortem confirms the disease.
- Requires laboratory assistance to see the microscopic abscesses in the brain.

Treatment
- Early treatment essential.
- Antibiotics.

Control
- Consider medication of feed in a lot of calves where one to two cases occur.
- This should be discussed with your local veterinarian.

Prevention
- Vaccine Called Somnugen is being evaluated in the field to prevent "sleepers". It is licensed in Canada.

November & December

Diseases Causing Abortion

Brucellosis (Bang's Disease)

Reportable Disease
- Under the jurisdiction of Health of Animals, Canada Department of Agriculture.

Cause
- Bacteria (*Brucella abortus*).

Transmission
- Introduction of infected cow.
- Infected genital discharges.

— Most frequently by ingestion.
— Through membranes of eye.
— At time of breeding.

Signs

— Abortions (usually 6th through 9th month of gestation.)
— Retained afterbirth.
— Swollen knees.
— Inflammation of testicles of bulls.

Diagnosis

— Signs.
— Blood and milk tests.
— Finding organism.

Treatment

— None.

Control

— Make sure all new additions to your herd are tested before arrival. If possible check the brucella status of herd and area of origin with Health of Animals.
— Test and slaughter reactors.
— Proper hygiene.

CAUTION — CAN BE SPREAD TO HUMANS.

Vibriosis

Cause

— Bacteria (*Vibrio fetus*).

Transmission

— Veneral disease; infection is introduced through reproductive organs at time of breeding.

Signs

— Drop in conception rate which may last 2 to 6 months (or longer) until cows develop immunity.
— Inflammation of reproductive tract.
— Long heat cycles.
— Abortion.
— Lack of libido (in bulls) due to an excessive number of cows returning to heat.

Diagnosis

— Not easy.
— Herd history.
— Tests on vaginal mucous (a single negative test is inconclusive).
— Finding organism.
— Transmission test using virgin heifers.

Treatment

— Spontaneous recovery is common, especially in young animals.

Cows — Infusions of uterus may have some value.
Bulls — Infusions of prepuce and injectable antibiotics.

Control

— Sexual rest (three months).
— Artificial insemination.
— Annual vaccination (30-120 days prior to breeding season).

Ergot

Ergot is an infestation of cereal grains, e.g., rye, oats, grasses, by the fungus *Claviceps purpurea*.

The toxic principle is a series of related alkaloids, e.g., ergotamine, ergonovine, which when fed to cattle, swine or poultry cause constriction of the arteries. If the constriction is severe enough the circulation to the lower parts of the limbs, ears or tail may be completely shut off, resulting in death of those tissues (gangrene).

Clincial Signs

— Symptoms include lameness and gangrene of the extremities. Also abortions in cows have been reported.

Bloat

Cause

— Gas formation is a normal product of rumen fermentation.
— Bloat occurs when gas formation exceeds gas elimination from the rumen.

Two Types:

Free Gas Bloat	— Obstruction of esophagus. — Over-filling of rumen. — Paralysis of rumen.
Foamy Feedlot or Pasture Bloat	— Gas trapped in frothy rumen contents.

Signs

— May develop rapidly.
— Bulging of rumen in left flank.
— Animal uneasy, anxious.
— Frequent urination and defecation.
— Shallow grunt, rapid breathing.
— Death may occur in less than one hour.

Treatment

Varies with degree of distention.

(1) Relieve gas — Stomach tube is preferred.
— Trocar or needle in left flank.

(2) Retard Fermentation and break foam.
— Mineral oil
— "Dioctol"
— Detergents

Some animals become chronic bloaters. The cause should be identified and corrected. Surgery can be effective, but it may be more economical to slaughter the animal.

Control

— High roughage rations.
— Avoid finely ground grain rations.
— Add antifoaming agents (e.g., mineral oil or poloxalene).
— Long grass roughage free choice.
— Avoid "high risk" pastures (e.g., young alfalfa).

Grain Overload — Rumen Overload

Cause

— Too much grain, too quickly, results in rapid fermentation and production of acid in rumen. The acid is absorbed into the blood stream and causes poisoning. A large proportion of the herd may be affected.
— Accidental break-ins.
— Starting on feed too rapidly.

Signs

— Usually develop in 12-18 hours.
— Three stages occur.

Mild	— Off feed and stand apart.
	— Profuse, watery diarrhea.
Moderate	— Weak, staggery.
	— Look full or bloated.
	— Diarrhea.
	— Dehydrated.
Severe	— Go down, comatose.
	— Toxic.
	— Shock, cold.

Treatment

— Depends on stage.

Mild	— Alakalizer to neutralize acid.
Moderate	— Empty rumen — via tube or rumenotomy.
	— Fluids intravenously.
Severe	— Slaughter as soon as possible.

Prevention

— Start cattle on grain rations gradually.
— Starter rations may be used for 21 days.
— At least 10% roughage in fattening rations.
— Proper mixing of rations.

Liver Abscesses

Occur on high grain-low roughage rations.

Real cause is not well understood, but generally believed to follow episodes of grain overload.

Usually no clinical effects, unless severe.

Results in condemnation of livers at slaughter.

Prevention

— High roughage - low grain mixtures.
— Antibiotics in feed; 70mg/head/day, during feeding period.

Sweet-Clover Poisoning

This is caused by certain fungi growing on the sweet-clover, *Melilotus* spp. The mould converts harmless, naturally occurring coumarol to the toxic dicoumarol, a compound which interrupts the clotting of blood. Cattle which are to be dehorned or castrated should not be fed mouldy sweet-clover for 10-14 days before surgery.

Footrot

Affects cattle the year round, but is worse under wet and muddy conditions.

Infection and inflammation of soft tissues of the foot.

Caused by bacteria in the soil.

Constant wetting from wet grounds, and foot injuries from stones or sticks predispose to infection.

Severe lameness, swollen soft tissues between the claws.

Can cause permanent lameness.

Treatment

— Early with antibiotics.
— Examine foot.

Prevention

— Good drainage of feedlot grounds.
— Concrete around waterers and feeders.
— Make cattle walk through mixture of 4.5 kg copper sulfate and 45 kg slaked lime.
— Organic iodides in feed.
— Paraformaldehyde mixed in soil.

Lumpy Jaw (Actinomycosis)

Cause

— Bacteria (*Actinomyces bovis*).

Transmission

— Organism gains access through injuries in mouth (e.g., tooth eruption, awns, fox tail) and localizes in bony tissues.

Signs

— Immovable bony swelling on upper or lower jaw.
— May discharge granular pus.
— May go unnoticed in early stages.

Treatment

— Difficult because of localization of the bacteria in bone.
— Antibiotics.
— Iodides.
— Isoniazid — used over an extended treatment period.
— Treatment response is poor in most cases.

Control

— Early diagnosis and treatment.
— Isolation of animals with discharging lesions.
— Organic iodides may reduce incidence.
— Avoid use of poor quality roughage.

Woody Tongue (Actinobacillosis)

Cause

— Bacteria (*Actinobacillus lignieresi*)

Transmission

— Organism gains access through injuries in mouth and localizes in soft tissues (e.g., tongue).
— Injuries often associated with feed (e.g., barley awns, foxtail in hay, sweet-clover).

Signs

— Excessive salivation.
— Difficulty with chewing.
— Tongue is often hard and may protrude from mouth.
— Often reddened lesions on surface of tongue.
— Animal will lose weight because of inability to feed.
— Chronic cases may occur and animals become poor doers.

Treatment

— Antibiotics.
— Iodides — sodium iodide intravenously is most effective.

Control

— Early diagnosis and treatment.
— Organic iodides may reduce incidence.
— Avoid poor quality roughage. Sweet-clover ground in mix mills may cause problems because of short sharp pieces of stem.

January & February

Polioencephalomalacia (Polio)

Acute swelling and degeneration of the brain causing a variety of nervous signs. Not related to disease of man.

Occurs mostly in feedlot cattle on high concentrate rations, but has been seen in cattle on pasture.

Cause

— Acute thiamine deficiency.

Signs

— Sudden onset.
— Blindness, staggering.
— Head pressing, stupor.
— Normal temperature usually.
— Go down, paddling and may die.
— May recover if treated early.

Treatment

— Thiamine HCl injection.

Prevention

— Increase roughage content of feedlot rations.
— Add thiamine to the ration.
— Remove cattle from problem pastures.

When signs of nervous system disease are seen, **call a veterinarian** early.

— Most conditions can be treated early with success.
— Most nervous diseases look alike.
— When one case occurs, it may mask the start of a problem in the entire herd.

Abomasal Impaction

Seen most frequently in wintering cows fed large amounts of poor-quality roughage, such as straw, usually finely ground or hammered. The grain or energy intake is minimal.

In cold weather the animal's nutritional requirements are increased and it tends to overconsume the light ration. The feed is allowed to pass to the fourth stomach (abomasum) before it has been properly digested by the micro-organisms in the rumen. The digested feed eventually becomes impacted in the abomasum.

Signs

— Slow onset.
— Depressed or sluggish.
— Off feed.
— Water consumption decreased.
— Firm, scant manure.
— Contents of rumen may be watery.
— Distended abomasum may be palpated or seen from right side of animal.
— Weak and staggering gait.
— Total recumbency in late stages.
— Death usually within 48 hours after going down.

Treatment

— Increase energy level of ration.
— Conserve body heat.
— Laxatives.
— Surgery.

Treatment is futile in advanced cases. Slaughter is usually advised.

Prevention

— Ensure energy content of ration is adequate.
— Avoid finely chopped roughages.
— Increase or feed grain during cold periods.

Urinary Calculi (Obstructive Urolithiasis; Water Belly)

Cause

— An obstruction of the urinary tract by a calculus (stone) in the bladder. It is especially common in cattle raised on high silicate soil (open prairies). Most often seen in weaned calves and yearlings.

If the stone is too large to pass through the urethra, it will become lodged and will force the urine to back up in the urinary tract. Eventually the bladder or the urethra will rupture and urine will be allowed to escape into the abdomen or the tissues around the urethra, along the belly.

The condition is rarely seen in females.

Signs

— Acute abdominal pain, stretching.
— Stamping of hind feet.
— "Windshield-wiper" tail.
— Pulsating anus.
— Urine excretion markedly diminished or stopped.

Later above signs disappear as animal is relieved when bladder or urethra ruptures. If the urethra has ruptured, swelling then appears along the sheath. However, if the bladder has ruptured the abdomen becomes swollen over a period of 3 or 4 days. Animal later becomes sick from urine poisoning.

Treatment

— Surgery is effective in early cases.
— Slaughter if bladder or urethra has not ruptured.

Prevention

— Defer castration until 7 to 9 months in problem areas.
— Encourage water consumption (e.g., add salt to ration).
— Ensure Vitamin A intake is adequate.
— Alfalfa hay prevents calculi formation.
— Balance calcium-phosphorus ratio.

Coccidiosis

Coccidiosis is an acute or chronic disease caused by small single-cell parasites (*Eimeria* spp). Animals acquire the parasites as eggs taken in with the food or water or soil. The parasites multiply in the gut lining, often causing serious damage. Many infected animals show no obvious signs. One type of coccidiosis is seen in the summer, associated with normal development by parasite. Another type of coccidiosis is seen in the winter and is thought to be brought on by stress. Young animals are the most commonly affected: at grass, in feedlots or housed.

Signs

— Off feed, loss of condition.
— Scouring, often watery with blood and mucous.

— Straining to pass feces.
— Loses weight.
— Dehydration, anemia, death (particularly with winter coccidiosis).

Diagnosis

Living animal — parasite oocysts in the feces but often disease noticed before oocysts form.

Postmortem — parasite stages in cells of intestinal lining.

Treatment

— Several drugs are effective against the parasite in the gut lining, but they must be given promptly.
— Supportive treatment to combat the effects of the scouring.

Prevention

— Prophylactic anticoccidial drugs given routinely or when there is a high risk of disease.
— For summer coccidiosis — grazing management particularly to avoid overcrowding susceptible animals where there is little grass.
— For winter coccidiosis — avoid overcrowding in a dirty environment, fecal contamination of food and water, feeding off the floor, stress (severe cold, other diseases).
— Animals infected with coccidia develop a resistance to further infection and in the future it may be possible to develop a vaccine.
— An awareness of the problem and early diagnosis and treatment can help reduce losses associated with coccidiosis — a management disease — consult your veterinarian.

Mange

Mange is a highly contagious disease caused by very tiny mites that live on or in the skin, where their whole life cycle takes place. The infection spreads among cattle when they are in close enough contact for mites or mite eggs to move from one animal to the next. Probably mange can also be transmitted via bedding, buildings and feeders. Four types of mange occur in cattle: Chorioptes — the commonest; Psoroptes — extremely rare in Canada; Demodex — rare in Canada; Sarcoptes — also rare in Canada. Infection is seen mostly in winter when animals are in close contact; any age of animal is affected.

Signs

Chorioptes — most common around feet, legs, tail and belly: irritation, weeping, scab formation, self-inflicted injury.

Sarcoptes — most common around escutcheon and inside thighs, may spread to abdomen and neck; loss of hair and skin swollen with numerous small red spots and scabs.

The skin damage associated with mange is different from that seen with lice. In addition, adult lice, which can usually be seen with the naked eye, are very much larger than adult mites. However, mange may be confused with lice that don't respond to treatment — consult your veterinarian.

Loss of productivity may be a feature of mange in cattle — associated with irritation.

Because mange is potentially a very serious disease, **all suspected cases of mange must be reported to CDA Health of Animals Division** — if in doubt consult your veterinarian.

Diagnosis

— Mites in deep scrapings taken from affected areas of skin — ask your veterinarian. Confirmation of the diagnosis is the responsibility of a federal veterinarian.

Treatment

Supervision of mange treatment in cattle is the responsibility of a federal veterinarian. Several available drugs are effective.

Prevention

Close contact between cattle at stockyards, shows and sales provides good conditions for the spread of mange, and the farmer may not recognize the infection in a newly purchased animal.

The proper use of drugs and avoiding overcrowding will help prevent the spread of mange on a farm.

EARLY DIAGNOSIS AND EFFECTIVE TREATMENT WILL HELP REDUCE LOSSES ASSOCIATED WITH MANGE.

March & April

Warts

Cause

— Virus.

Transmission

— Usually direct from one animal to another but can be spread indirectly on such things as feeders and fences. Instruments such as hypodermic needles, tattooing equipment, ear taggers, and back rubbers have been involved in spread of warts.

Signs

— Irregular cauliflower-shaped lesions of variable size. All parts of the skin can be affected but the head and neck are most frequently involved, likely from rubbing.

Treatment

— Usually clears up spontaneously.
— Castor oil.
— Wart vaccine.
— Surgery.

Prevention

— Cleanliness with instruments.
— Isolation of affected animals.

Ringworm

Cause

— Fungus

More common in animals housed in close proximity for long periods.

Young stock are more often affected than adults.

Ringworm in cattle spreads readily to humans.

Transmission

— Direct — from animal to animal.
— Indirect — bedding, walls of stall, grooming equipment.

Diagnosis

— Characteristic lesion — grey-white crust rising above skin, plus evidence of infectivity.
— Microscopic examination of skin scrapings.

Treatment

— Often not satisfactory but prevents spread to other animals.

Be sure to wear gloves and ensure they are put away in a safe place. Burn scrapings.

— Scrub lesion with stiff brush and apply mild iodine solution.
— Tinevet.
— Thiabendazole (dewormer).
— Sunlight — will clear up when cattle are on pasture.

Control

— Isolation and treatment of infected animals.
— Cleaning and disinfection of pens. 2.5 - 5% phenol; 2% formaldehyde and 1% caustic soda.
— Good nutrition.

Hardware Disease (Traumatic Reticulitis)

Cause

— Nails or metallic objects which have been swallowed, puncture the wall of the first stomach (reticulum).

Acute Hardware Disease

Signs

— Suddenly off feed, move slowly.
— Fever.
— Pain in area of breast bone.
— Reluctance to defecate and urinate.
— Sudden drop in milk production.
— Grunt when bumped or walking.

Acute Cases Can

— Completely recover.
— Lead to vagus indigestion.
— Become chronic.
— Die suddenly.

Treatment

— Elevate front quarters.
— Administer a magnet.
— Administer antibiotics.
— Surgery to remove foreign object.

Chronic Hardware Disease

— May be difficult to diagnose.

Signs

— Unthrifty, poor doers.
— Milk fever.
— Chronic bloat may occur.
— Engorgement of blood vessels of neck.
— Swelling of neck and lower abdomen.

Treatment

— Surgery.
— Salvage through slaughter.

Prevention of Hardware Disease

— Magnets in milling equipment.
— Magnets given to cattle.
— Clean up pasture, lots or hay fields.

Vagus Indigestion

— Difficult to diagnose.
— Caused by damage to one of the nerves supplying forestomachs.

Signs

— Off feed.
— Slight bloat, full on left side.
— Scanty manure.

Treatment

— Salvage through slaughter.

Grass Tetany

This disease is most prevalent in late winter or early spring; it is associated with lower than normal levels of magnesium in the blood stream. Rather than a simple deficiency of magnesium in the diet, it is probably a matter of various factors interfering with the absorption and metabolism of magnesium e.g., Calcium, phosphorus and sodium as well as energy intake may be involved.

Signs

— Cows nursing a young calf or close to calving are usually affected.
— They become nervous or unusually alert, often belligerent, develop a staggering gait, muscle twitching and finally become recumbent.
— Animals are often found down with the head back and legs "paddling".

Treatment

— Animals treated early usually respond well to intravenous magnesium and calcium gluconate solutions. Animals treated in the late stages of the disease often respond temporarily but fail to make a complete recovery.

Control

— The disease may be controlled by providing a magnesium supplement such as magnesium oxide at the rate of 60 grams per head per day.
— Shelter should be provided in inclement weather and care taken to see that the ration provides an adequate energy level.

Prolapsed Vagina

Prolapsed vagina is a condition in cows where the hind part of the genital passage protrudes from the body, usually two to three weeks before calving. The exposed vagina becomes dirty and sore, causing the cow to strain and make the condition worse. The vagina is usually replaced and retained with sutures and the animal observed closely until calving. Such animals should be culled in the fall as the condition is likely to recur annually and there appears to be a genetic susceptibility to it.

Calf Scours

Diarrhea in young calves may be due to bacteria, viruses, nutritional deficiencies, cold, stress or a

combination of these or other factors. Heifers' calves are more susceptible than cows' calves. Most calves are affected in the first two weeks of life.

Signs

— The diarrhea may vary in color and severity according to the cause.
— The calf becomes weak, depressed and dehydrated. The dehydration is shown most dramatically by sunken eyeballs.
— Death may occur in a few hours or three to four days after scouring is first noticed.

Treatment

In consultation with your veterinarian, the treatment of calf scours may include:

— Identification and isolation of sick calves from the rest of the herd.
— Treatment with antibiotics or antibacterials.
— Fluid and electrolyte replacement.
— Changing the calf's diet.
— Use of intestinal protectants.

Each scouring calf should be identified so that you can tell when it started to scour, how many times it has been treated, and which cow it belongs with.

Isolate scouring calves from the rest of the herd and treat them early. To avoid carrying infection from sick to healthy calves, wash hands and boots and change overalls before moving between groups.

Antibiotics and antibacterials have been used for many years to treat scouring calves. They can be administered by mouth (orally) or by injection. There is good evidence to suggest that oral administration is beneficial in the treatment of scours caused by bacteria such as *E. coli*, but the data do not indicate whether or not it is useful in treating viral scours. However, oral administration of antibiotics is usually recommended because:

— It is often not possible to tell whether the cause is bacterial or viral.
— Infections in calves and herds are often mixed, i.e., bacterial and viral.
— Because it may reduce the possibility that intestinal bacteria will enter the bloodstream.

The usual recommendation is to administer two boluses when scours are first seen, then one additional bolus 12 and 24 hours later. If there is no clinical response by the time 4 boluses have been given, it is unlikely that the preparation will be beneficial.

Injection with antibiotics for three to four days may also be recommended. Consult your local veterinarian for advice regarding which antibiotics are most effective in your area.

Scouring calves lose body fluids and electrolytes such as sodium, chloride, and potassium. When dehydration occurs the fluids and electrolytes must be replaced. To assess the amount of dehydration present, observe the eyes and elasticity of the skin.

Depending on the degree of dehydration, fluids may be given intravenously or by mouth, either by stomach tube, esophageal feeder, or nipple bottle if calves are strong enough to suck. Intravenous administration requires sterile equipment and solutions as well as careful calculation of the rate and volume of fluids to give and is therefore best done only by or under the supervision of a veterinarian. Oral administration is simple, rapid, inexpensive, and does not require sterile equipment. Therefore, along with antibiotic therapy, it forms the backbone of an on-the-farm "treatment program". Most moderately and even some severely dehydrated calves can be maintained on orally supplied fluids.

— Calves which are scouring, but which are nursing and hard to catch usually do not require fluids.
— Calves which are depressed and are still able to stand and suck may only require 1-3 litres from a nipple bottle, given as 1 litre every 6-8 hours.
— Calves which will not suck or stand but are strong enough to lie holding their head up require approximately 1 litre by stomach tube every 6-8 hours until they are able to stand or until the diarrhea stops. Heat lamps are also beneficial if available.
— Calves which lie flat out and which cannot sit up without support usually require intravenous fluid therapy and veterinary attention. These calves often experience severe drops in body temperature and should be covered with a blanket or sack and kept warm if transported. Calves which are responding to fluid therapy become brighter, stronger and begin to urinate usually within 8-12 hours.

Restricting the milk intake of calves for 24 hours following the onset of diarrhea may be helpful and is recommended in individual cases where the cow can be milked out and left with the calf. During outbreaks it is not practical to milk out the cows, and since separating the calf from the dam causes considerable stress this procedure is not recommended.

Several commercial preparations which contain Kaolin and Pectin are available; however they have not been shown to be beneficial. Some producers feed raw eggs; however, this may be detrimental since calves cannot digest egg protein.

Prevention

Host factors such as the nutritional and immune status of dams and calves play an important role in determining whether or not scours will occur.

— Nutrition — Cows should receive proper nutrition throughout the winter to avoid:
  — weak cows which have difficulty calving and which may produce an insufficient volume of colostrum and milk, and
  — weak calves which cannot stand to nurse and which cannot survive extreme changes in the weather.
— Immunity — In the newborn calf there are two types of immunity: nonspecific immunity against infection in general, and specific immunity which protects against particular infectious agents. Maximum nonspecific immunity can be obtained by proper nutrition of pregnant dams to ensure that calves are born healthy and vigorous and that they ingest a large volume of

colostrum soon after birth. Under natural conditions, most beef calves are on their feet and nursing within 30 minutes of birth and will obtain sufficient colostrum unless the dam is deficient. When nutrition is adequate, most cows will produce sufficient colostrum to protect their calves; however, herd problems may develop when poor quality or insufficient feed is provided. Calves born to first-calf heifers often do not receive sufficient colostral protection for several reasons:

- heifers do not produce as much colostrum as cows.
- heifers' colostrum does not contain antibodies against as many different agents.
- heifers do not mother calves as well as older cows.
- heifers which have difficulty calving may produce weak calves which are slow to rise and nurse.

Delay or failure to ingest colostrum may also occur when animals are overcrowded. Under these conditions, calves may have difficulty locating their dam, and the normal nursing pattern may be disturbed by other animals.

Calves which are weak and unable to stand at birth may require special attention. If they have not nursed within two or three hours, they should either be helped to stand and suckle, or the dam should be milked out and the calf fed by nipple bottle. Calves should receive a volume of colostrum which is at least equivalent to 5% of their body weight before 12 hours of age (e.g., one litre per 20 kilograms of body weight or 1 qt for 50 lb of body weight) and which is best given in two or three feedings. It is not necessary for a calf to receive colostrum from its own dam. Colostrum from high-producing cows or from a neighbor's dairy cows may be stored frozen in plastic bags or containers until needed. Handfeeding a weak calf may prevent the first case of scours which initiates an outbreak.

The environment refers to the physical (e.g., climate, shelter, soil) and biological (e.g., other animals including man) factors surrounding individual animals in the herd. Surveys conducted in Alberta and Saskatchewan have indicated that several factors are important.

- Population density — The amount of usable space which is available to animals during the wintering and calving period may be one of the most critical factors determining the occurrence and severity of outbreaks of scours. Severe crowding or crowding for long periods of time increases the level of contamination in the environment of the newborn calf. This buildup of environmental contamination becomes more severe as crowding increases; in some herds newborn calves are exposed to very high numbers of infectious agents soon after birth. The amount of environmental contamination may be so high that it overwhelms natural colostral immunity and the protective effect of vaccines.

Crowding also increases the amount of stress on the animal, particularly newborn calves. Under crowded conditions, newborn calves may have difficulty finding and nursing their dams early and therefore may not ingest sufficient colostrum. When not nursing, newborn animals normally spend most of their time sleeping. However, when crowded, they may find it difficult to locate a quiet, comfortable resting place where they will not be trampled and buffetted by other animals. It is desirable to calve first-calf heifers in a separate area where they can be observed and assisted if necessary; however, situations where there is less than 185 m^2 (roughly 2000 ft^2) of available space per heifer should be avoided. If weather permits, cows should not be confined for calving.

- Wintering and calving procedure — the percentage of calves that scour is lowest in herds where first-calf heifers and older cows are wintered and calved separately, and highest in herds where heifers and cows are wintered separately and then brought together for calving.

There are several possible reasons for this.

- In herds where heifers are calved separately, heifers are normally confined so they may be observed and assisted, whereas cows are less confined or calved in the open. When heifers and cows are calved together, the entire herd tends to be confined so that heifers may be watched.
- When heifers and cows are wintered separately and then run together for calving, animals in either group may be exposed to infectious agents to which they are not immune.
- In a mixed group there may be an increase in stress because older cows may interfere with the normal nursing pattern of calves born to heifers.
- Location of the dam at calving — Calving inside barns, sheds and shelters, even if calves are turned out before a day of age, increases the risk of scours.
- Weather — Outbeaks of diarrhea frequently follow cold weather accompanied by wind and snow or rain. The specific mechanism by which changeable or stormy weather affects the occurrence of scours is not known. However, bad weather may increase stress, alter the nursing pattern of calves, and lead to wet ground surface conditions. Animals may also be crowded together as they seek natural or man-made shelter.
- Ground Surface Conditions — During the 48 hours immediately preceding outbreaks of diarrhea, ground surface conditions in calving areas are most frequently wet as opposed to dry. Excess ground surface water not only makes it difficult for calves to find a comfortable place to sleep, but also may transmit infectious agents. Conversely, a dry, frozen, or snow-covered surface may decrease the amount of contamination. Ground surface water is present during the spring thaw or following spring storms, and the problem is often compounded by improper location of calving grounds: low areas with improper drainage should be avoided.

Based on the above discussion, producers can identify factors which increase the risk that scours will occur in their herd. The greater the number of risk factors the greater the probability that scours will occur.

Risk Factors

- Heavy snowfall.
- Chance of storms during the calving season.
- Ground surface water in the calving area.
- Overcrowding or confining for long periods.

— Calving in barns or shelters.
— Wintering and calving heifers and cows together.
— Improper nutrition.
— Birth of weak calves.

Recommendations for Prevention of Scours in Beef Herds

Because of differences in herd size, availability of facilities and labor, and general management techniques, it is impossible to recommend specific management procedures which are applicable to all situations. However, there are some broad management principles which producers should attempt to adapt and integrate into their operations.

— Supply an adequate winter ration.

— Proper location of calving grounds.
  — Do not winter and calve on the same ground.
  — When calving on range, locate calving grounds where there is some natural shelter and windbreak. If semiconfinement calving is necessary, be sure some high ground with good drainage and a southerly exposure is available. Avoid low-lying areas.
  — Ensure access to natural or man-made shelter. Calving huts may be used, but should be moved and freshly bedded regularly.
  — Try to avoid calving on the same ground year after year, particularly if you have previously experienced scour problems.

— Proper preparation and maintenance of calving grounds.
  — Monitor snowfall throughout the winter and anticipate excess snow buildup. Begin snow removal early during the winter. At least once before the onset of calving plough strips 6 - 7 m (20-25 ft) wide and open spaces which can be used for feeding and loafing areas. Cleared areas should have a southerly exposure and be on elevated ground to avoid accumulation of water when snow melts.
  — Turn cattle into these areas as soon as weather permits and use placement of feed and water to disperse them.
  — Provide clean, dry bedding regularly so cows' udders and underbellies stay clean and to ensure calves have a dry comfortable place to sleep.
  — If one section of the maternity area appears to become contaminated, or drainage is poor, fence it off until conditions improve. As more ground becomes bare, increase the amount of space available to animals.

— Avoid overcrowding and prolonged confinement during both wintering and calving periods.
  — Do not calve heifers and cows together.
  — Whenever possible, calve in the open and if possible divide main herd into smaller groups. If scours occurs in one group try to avoid carrying contamination to other groups.
  — If semiconfinement is necessary, reduce population density in the immediate calving area. This may be done by dividing the main herd into smaller groups based on anticipated calving dates or by rotating expectant dams through the calving area. Disperse calved out animals as soon as weather permits. In addition to decreasing population density, calving and dispersing calves in groups is believed to greatly reduce stress.
  — Avoid the use of barns or sheds for prolonged periods.
  — Provide at least 185 m^2 (2,000 ft^2) of calving space per heifer, i.e., no more than 20 heifers per acre.

— Minimize stress on newborn calves. Much of the damaging stress that often affects newborn calves can be removed by:
  — preventing overcrowding.
  — supplying clean, dry bedding.
  — providing access to natural or artificial shelter when the weather is bad.
  — providing proper wintering rations to ensure cows and calves are strong at calving and that calves receive adequate colostrum of high nutritional and immunological quality.

— Provide extra care for weak calves.
  — A weak calf which develops scours may be the start of an outbreak. Therefore check calving cows and heifers regularly and provide assistance when needed.
  — Provide a sheltered area where assistance may be given.
  — If a weak calf is born, help it to stand and nurse early or be sure it is fed colostrum by nipple bottle or stomach tube.
  — Separate weak calves from the rest of the herd for several days to be sure they are healthy.

Navel Ill

Cause

— Bacteria

Transmission

— Bacteria enter through unhealed umbilical cord.

Signs

— Swollen, hot, tender navel.
— Fever.
— Often calf refuses to suck.
— Painful joints, calf will not get up.
— Scours, dehydration and depression.

Treatment

— Antibiotics.
— Clean up navel thoroughly.

Control

— Calve cows in clean surroundings.
— Disinfect navels at birth with **tincture** of iodine.
— Ensure calf receives colostrum immediately at birth.

Necrotic Laryngitis (Calf Diptheria)

Age Group

— Young calves to yearling age.

Cause

— Bacterial

Signs

— Loud snoring noise when inhaling.
— Painful cough and swallowing movements.
— Off feed, depressed and painful.
— Throat swollen and painful.
— Drooling and snotty nose.
— Bad breath.

Treatment

— Detect and treat early.
— Sulfas.
— Antibiotics.
— Tracheotomy may be necessary.

Control

— Usually affects nutritionally deficient animals in poor sanitary conditions, so good feeding, and management are essential.
— Early diagnosis and treatment of affected animals and isolation of affected animals prevents spread.

Viral Pneumonia of Calves

Age Group

— Commonly calves 2 to 6 months old.

Cause

— Viral, often complicated by bacteria.

Predisposing Environmental Factors

— Overcrowding.
— High relative humidity.
— Draftiness.

Signs

— Usually a herd problem
— Fever (40°C i.e. 105°F or higher)
— Nasal discharge.
— Dry hacking cough.
— Rapid respiration.
— Most calves will recover spontaneously in 4 to 7 days.
— If secondary bacterial invasion occurs, calves become more depressed and disease is prolonged.

Diagnosis

— On signs.
— Nasal swabs to help determine what bacteria are present.

Treatment

— Good nursing care.
— Antibiotics ineffective against virus but useful in secondary bacterial pneumonia.

Control

— Good management and housing.

White Muscle Disease (W.M.D.)

White muscle disease is most common in those areas where there is a deficiency of selenium in the soil. Such a condition exists in most gray wooded soil areas. The cause of the disease is a deficiency of selenium or vitamin E. The exact relationships of these substances to W.M.D. is not completely understood. Vitamin E deficiency is often seen when the ration consists mainly of poor hay and straw. Green hay and grains are good sources of vitamin E.

Rancid fat destroys vitamin E, so prepared rations that are supplemented with oils and fats should be fed when freshly mixed and not stored for more than a few days. Unaccustomed muscular activity, such as when calves are turned into pasture after barn confinement often precipitates an occurence of W.M.D. in borderline cases of vitamin E deficiency.

Signs

— Signs of the disease relate to muscle function. The skeletal or heart muscles may be affected.
— Affected calves may be weak, tire easily or die suddenly after exercise.
— Muscles may be hard or swollen and there may be knuckling of the joints or trembling of the limbs.
— Difficulty in swallowing may be an early sign.
— Breathing may be abnormal because the respiratory muscles are affected.

Treatment

— Treatment consists of oral or injectable selenium and vitamin E preparations.

Control

— Control is based on avoiding diets deficient in selenium or vitamin E.
— Supplementing the diet with 0.1 parts per million (ppm) of selenium or feeding 1 gram of alphatocopherol daily to cows before calving is recommended in areas where W.M.D. is a problem. In such areas, routine injections of selenium and vitamin E are usually given to calves at birth.

May, June, July & August

Spondylitis

Occurrence

— Seen in older, overweight bulls that have been used primarily on rough pasture breeding areas.

Signs

— Weakness and paralysis of hind legs of the bull.
— Appears drunk just on the hind legs.
— Can be sudden paralysis of hind legs.

Cause

— Arthritis and new bone proliferation in and around the spinal nerve which puts pressure on the spinal nerve, causing paralysis of the hind quarters.

Treatment

— None.
— Slaughter.

Prevention

— Do not keep bull in over-fat condition.

Pink-Eye

Cause

— Bacteria *(Moraxella bovis)*
— Stress of radiation or sunlight and eye injuries also a factor.

Transmission

— Direct.
— Indirect (flies).

Signs

— Excessive discharge from eye.
— Inflammation of the lining of the eye.
— Cloudiness or whitening of cornea (surface of eye).
— Ulcers of cornea.

Treatment

— Early treatment important.
— Ointments (e.g. mastitis ointment) in eye.
— Eye patches.
— Injection of membrane with penicillin.
— Sprays and powders will cause more irritation.

Prevention

— Control flies.
— Control dust.
— Early treatment.
— Ensure vitamin A levels are adequate.

Advanced cases of pink eye may be confused with malignant growths (cancer eye). The latter condition necessitates surgery. IBR can also cause whitening and watering of the eye.

Tetanus (Lockjaw)

Cause

— Bacteria *(Clostridium tetani)*

Transmission

— Spores are introduced through wounds and locate in tissues. Puncture wounds are particularly common as sources of infection. In cattle, tetanus is often associated with wounds of the birth canal following calving and also castration wounds. Cases of retained afterbirth have resulted in tetanus. Tetanus is most important as a disease of horses.
— Toxins are produced which irritate the nerves supplying muscles, causing them to go into spasm.

Signs

— At first a stiffness and later severe spasms brought on by sudden movement or noise. Death occurs from nerve damage and or involvement of muscles of respiration.

Treatment

— Tranquilization (e.g., quiet darkened stall).
— Cleaning and disinfection of wound.
— Antibiotics.
— Antitoxins may be helpful — only in massive doses.
— Nursing is important — food should be palatable and easily swallowed.

Prevention

— Removal of puncture wound hazards (nails).
— Care at time of surgery and calving.
— Vaccination if indicated.

Note — Tetanus can affect all animals, **including humans.**

Lead Poisoning

Some of the more common sources of lead are: lead-based paints, storage battery plates, used grease and crankcase oil from gas motors, linoleum and roofing paper, window putty, plumbing and caulk, etc. In almost all cases animals gain access to sources of lead through negligence.

Symptoms of poisoning appear within a few days to two weeks following exposure to lead. Often younger animals are more severely affected than older ones. Cattle tend to show the following symptoms; however, all the symptoms may not occur in each animal.

Signs

— Decreased appetite, transient constipation followed by diarrhea, abdominal pain, grinding of teeth, abdomen tucked, walking in circles, pushing their head against objects, twitching of ears, bobbing of head, lack of muscular coordination. Most animals may appear depressed but become very excited, especially when disturbed, and may undergo convulsive seizures.

Lead poisoning, at times, looks very much like **RABIES,** so handle such animals very carefully, and seek help from the veterinarian immediately.

Tentative diagnosis of lead poisoning may be made on the basis of history, symptoms, and postmortem examination. In the post mortem, varying degrees of gastroenteritis, degenerative changes in the liver and kidney, may be seen. Confirmation of poisoning is achieved through chemical analysis of blood from live animals, and kidneys, liver and bones from dead animals.

Other Poisoning

Organophosphates and Carbamates

These insecticides are included in many products. Some are applied to the backs of cattle to kill grubs and are quite safe when used in accordance with the manufacturer's instruction. Others are used for a wide variety of purposes in agriculture and can either contaminate cattle foodstuffs or may be eaten if they are not stored away safely. When absorbed or ingested in toxic quantities they act on the nervous system in various ways.

Signs

— Symptoms of poisoning with organophosphates or carbamates include: initial excitement, difficulty in breathing, profuse salivation, sweating, tears, urination, gums tend to become bluish in color, colic and sometimes diarrhea, muscular twitching, staggering, paralysis, depression and death.

Organochloride Insecticides

This group consists of compounds such as DDT, kelthane, methoxychlor, lindane, aldrin, dieldrin, endrin, chlordane and heptachlor epoxide. Use of these compounds is decreasing because they tend to persist in nature for a long time (in some cases several years). This increases their potential toxicity not only for the parasites but for the host as well. Some of them are suspected of promoting cancer. Furthermore, their long life tends to create unacceptable levels of residues in the meat, eggs and milk from treated animals.

Most frequent causes of poisoning by these insecticides have been associated with overtreatment or the mistaken identity of these insecticides for other substances such as mineral mixtures. In some cases stored feed became contaminated with poison as a result of improperly stored insecticides.

Signs

— In cases of acute poisonings animals become apprehensive, hyperexcitable, wander aimlessly, try to jump imaginary objects, stumble into objects, make chewing movements continuously causing foaming at the mouth, stay in abnormal postures, show muscle twitches which may progress into convulsions interrupted by periods of depression. Coma and death may ensue.

— Diagnosis is made with the help of history, symptoms, and chemical analysis of liver, kidney, stomach contents, fat and hair.

Treatment

— Treatment is attempted by relieving the symptoms and preventing further exposure to the poison.

Products from contaminated animals are likely to contain unacceptable residues of the insecticide for a long time. Therefore, advice from the veterinarian and the federal and provincial authorities must be taken for disposal of such animals and their products.

Ammonia and Urea Poisoning

Urea and many ammonia derivatives are used as substitutes for natural protein in ruminant feeds. If not used properly, they can act as lethal poisons instead of nutrients. Urea is generally recommended in ruminant rations at a rate of approximately 3% of the grain ration or about 1% of the total ration. Ruminants suffering from malnutrition, disease, or those not used to urea in their feed do not tolerate it well.

Signs

— Animals become sick within ten minutes to four hours after consuming a toxic dose. They show signs of abdominal pain, e.g., kicking at the abdomen, grinding teeth, bellowing, salivation, bloat, muscle tremors and weakness, unsteady walk, frequent urination except near death, forced rapid breathing, violent struggling and death. Carcass decomposes rapidly after death.

Diagnosis

— Diagnosis is made with the help of history, symptoms, postmortem lesions, (e.g., edema and congestion of lungs, catarrhal gastroenteritis and marked odor of ammonia), and chemical analysis of feed, blood and rumen fluid.

Treatment

— Treatment consists of drenching the cattle with 8-12 litres of dilute acetic acid (vinegar) and 20-40 litres of ice cold water.

Arrow-Grasses

Seaside arrow-grass *(Triglochin maritima)*

Marsh or small-arrow grass *(Triglochin palustris)*

Herbaceous, perennial, grass-like plants 15 to 76 cm (6 to 30 in.) tall. Common in damp soils, marshes, and sloughs, usually where soil is alkaline or water is brackish.

Arrow-grass starts to grow earlier in the spring than associated true grasses and regrow more rapidly than grasses after cutting. It is more dangerous at these times because of its availability. Livestock will eat it more readily at all times for its salt content. Hay containing arrow-grass gradually loses its toxicity with time. Cattle are most often affected and sheep are also susceptible.

Water Hemlock (Cowbane) *Cicuta* spp.

This has been considered to be the most poisonous plant in North America. Water hemlock is a member of the family Umbelliferae (parsley or carrot family) and is a herb having leaves with serrated edges and veins proceeding to the edge of the leaf. It is found in wet places; stands of water hemlock tend to persist from year to year in the same spot. The thickened root system stores the food reserves for the plant and is the most useful feature in distinguishing the plant. The pungent oil in the root system changes from yellow to red within a few minutes of exposure to the air. The bundle of roots is like those of dahlias, with hollow internodes and diaphragms of pith tissue across the cavities.

The toxic principles are unsaturated alcohols, cicutoxin and cicutol. The highest concentrations are in the roots and rootstocks. Sheep and cattle are most commonly affected, with symptoms developing within 15 minutes of ingestion. The symptoms include violent convulsions, salivation, diarrhea (if it survives acute phase). Death is from asphyxia.

Poisonous Algae

The accumulation of algae on water is called "bloom" and usually consists of only one or two types of algae. The nature of the bloom can change fairly quickly. Formation of bloom is dependent upon a series of interacting factors, e.g., wind, season, temperatures, nutrients, degree of oxygenation of water, water flow, etc. Only three species of blue-green algae are commonly involved, not always together.

There are several toxic compounds that may be involved. Death may occur within 1-48 hours after ingestion of the algae bloom, depending upon the species involved.

Nitrates and Nitrites

Nitrate toxicity occurs most commonly from plant and water sources. A list of plants known to accumulate nitrates is given below. The accumulation of nitrates in plants is greatest in the stalks and less in the leaves. Fertilizers, for example, ammonium or potassium nitrate, are sources of nitrates to both plants and animals. Water leaching from manure piles and nitrate fertilized soils draining into dugouts can be a source of poisoning.

Ruminants can easily convert nitrates into nitrites, which are readily absorbed and are quite toxic. The nitrites oxidize the blood hemoglobin to methemoglobin, which is then not available to transport oxygen.

Poisoning usually occurs within hours of ingestion, and symptoms include rapid breathing, slobbering, muscular weakness, abdominal pain and muddy discoloration of the mucous membranes and whites of the eyes. If the intake of nitrates is very high, the animal will die after a brief coma. On occasion symptoms are not apparent until 4-5 days after ingestion of nitrates. The symptoms in these

cases include unthriftiness, increased susceptibility to illness and a failure to conceive.

Some Plants Known to Accumulate Nitrates

Oats	*Avena sativa*
Beet	*Beta vulgaris*
Rape	*Brassica napus*
Alfalfa	*Medicago sativa*
Rye	*Secale cereale*
Wheat	*Triticum aestivum*
Corn	*Zea mays*
Pigweed	*Amaranthus* spp
Canada thistle	*Cirsium arvense*
Sweet-clover	*Melilotus officinalis*
Dock	*Rumex* spp
Russian thistle	*Salsola pestifer*

Gutworms

Gutworms are associated with acute or chronic diseases. Animals acquire the infection as larvae (immature parasites) taken in with the food, usually pasture grass. Once they are eaten by the animal, these larvae migrate into the lining of the gut, then return to the cavity of the gut where they become adults. Under ideal conditions the whole cycle, adult to adult, takes about one month. Many infected animals show no obvious abnormalities. However, the levels of infection present in prairie cattle, while rarely producing acute disease, MAY significantly reduce milk production, rate of gain or feed conversion efficiency. It is probable that in the prairies, gutworms are most important among young animals at pasture, particularly calves in the fall, but their effects may also be seen in adult cattle and in housed and feedlot animals.

Signs

— Depressed production
— Loss of condition, off feed
— Scouring, dehydration, anemia, edema: generally obvious only in acute cases.

Diagnosis

Living animal — microscopic (0.1 mm long) parasite eggs in fresh fecal sample, BUT disease can appear before eggs.

Postmortem — adult parasites in gut cavity (with care may be seen with naked eye); evidence of damage to gut lining associated with immature parasites.

Treatment

Several anthelmintics (wormers) are effective against adult parasites but not against immature forms in the gut lining — used for acutely affected animals.

Supportive treatment for severely affected animals, e.g. good nutrition, and adequate shelter.

Prevention

The combination of actions will vary from farm to farm — consult your veterinarian.

Grazing management — particularly avoid overcrowding animals of mixed ages on areas where there is inadequate grass. Older animals are the main source of infection for young stock — parasite eggs and larvae probably will not survive in significant numbers on pasture over winter.

Prophylactic use of anthelmintics — in the prairies probably rarely needed to prevent acute disease, but their use MAY lead to increased production.

An awareness that the problem may occur and that the remedy should be effective and prompt is very important.

Lungworm

Lungworm is an acute or chronic infectious disease caused by a parasite *(Pictyocaulus viviparus)*. Animals acquire the infection as larvae (immature parasites) taken in with the food, usually pasture grass. These larvae have developed from larvae in the manure of infected cattle. Once they are eaten by the animal, these larvae migrate through the lung where the adult worms live in airways. Many infected animals show no obvious abnormalities — disease is usually seen in young stock toward the end of their first season at grass, but it may also occur in feedlot or housed animals.

Signs

— Difficulty breathing, coughing
— Off feed, loss of condition
— Scouring (sometimes in early stages)
— Fever (associated with bacteria and viruses invading the damaged lung)
— Death

Diagnosis

In the living animal — parasite larvae in fresh fecal samples BUT disease can appear before larvae.

On post mortem — adult parasites in airways (look like pieces of white string); damaged lung tissue.

Treatment

Some anthelmintics will kill both immature and adult parasites. Treat all animals in the affected group.

Supportive treatment for lung damage.

Prevention

An awareness that the disease may occur — often appears on a farm year after year.

Grazing management — older animals are the main source of infection for young stock — parasite larvae will not survive on pasture over winter.

Prophylactic use of anthelmintics — probably only justified on a farm where the disease is a frequent severe problem.

The vaccine available in Europe is not marketed in Canada. Early, accurate diagnosis and treatment, including all susceptible animals, may not prevent the disease but it should prevent serious losses caused by reduced production.

Nursing Sick Animals

Although there are many powerful and effective drugs available, it is important to realize that medication alone will not produce as rapid or as complete a recovery as will be the case if simple nursing procedures are followed as well.

Disease in itself is stressful. Fever causes stress. Loss of appetite and subsequent lowering of energy reserves can contribute to stress. Fluid loss in diarrhea causes

serious heat loss from the body and this causes stress. Therefore, it is logical that in sickness other stressful conditions such as cold, excitement or distress should be minimized as much as possible. This is a basic principle of animal nursing.

Cold

Extremely low temperatures can adversely affect the rate of recovery of a sick animal. Generally, a hardened animal will have grown a sufficiently thick coat to handle all but the lowest temperatures. It is a mistake to bring such an animal into a warm atmosphere, although in sub-zero temperatures there is an advantage in confining it at a temperature a few degrees above freezing. For short periods in extreme illness a quilt made of several gunny sacks sewn together filled with loose hay is useful. As the need becomes less acute, the hay may be removed from the sacks, and finally the sacks themselves may be removed.

Thick straw bedding protects the body from heat loss to the ground, for it must be remembered that the sick animal will spend much time lying down.

Moisture

Moisture such as melted snow or rain penetrates to the skin and destroys the insulation of the coat, lowering the temperature as the moisture evaporates. It therefore follows that when there is risk of rain or snow, a sick animal must be housed under cover.

Wind

Currents of air are the most serious cause of reducing body temperature, and therefore complete protection from the wind must be provided for sick animals.

Old barns or corrals may be made proof against the wind by constructing straw bale walls topped by fence poles, plywood and more straw bales.

Heat

Hot weather can be equally disturbing to the sick animal. Shade and good ventilation are required to meet these conditions.

Isolation

Isolation is, of course, an important disease control measure. However, isolation in a place free from stress, for example in a location away from noisy children or a barking dog, will reduce anxiety in the animal. You should try to avoid loud noises in treating such animals, particulary animals that are not adjusted to confinement.

Feed and Water for the Sick Animal

Sick animals tend to slobber in drinking water and on their food. Both food and water develop an odor unpalatable to the animal. Therefore, water should be changed often, and food offered in small amounts and then discarded. As the animal starts to recover, feeding may be encouraged by placing wisps of sweet hay in the animal's mouth. Fresh grass such as lawn clippings may be offered in handfuls; in winter a small amount of household vegetables may stimulate an interest in food. Sick animals appear to have a reduced ability to taste, and offering a little food at frequent intervals seems to be a profitable course.

When animals are clearly weakened through lack of feed, old-fashioned remedies may be considered, such as a litre of warm milk water containing 0.2 kg (0.5 lb) of glucose or corn syrup and a 15 mL (1 tbsp) of powdered ginger. Giving this material as a drench must be carried out with extreme caution to avoid the animal taking any of the material into its lungs.

Care of the Downer Animal

Animals invariably seem to go down in unsuitable or inconvenient locations. For short distances, say 3 m (10 ft) or so, an animal may be slid along on its side on a layer of dry straw. Traction should be applied to a halter and to a rope attached to the under fore limb. A rope around the hind quarters can also be used to give assistance. For transportation over longer distances, a skid must be provided or a field gate may be used. The apparatus should be covered with a tarpaulin and straw, and the animal rolled onto the skid on its side. The head should be tied down and the entire load hauled away by tractor. Care must be taken that ears and tail do not get caught between the skid and the ground.

Locating Down Animals

Downers must be given protection from the elements, hard slippery floors must be avoided and the location must be well drained. A base of wet bedding about 225 mm (9 in.) thick should be covered with an equally thick layer of dry bedding. Many downer animals could rise with a good footing but fail to do so because they lose the will to try when the floor is slippery.

Turning

A weak animal will tend to lie continuously on one side. The weight of the body will tend to compress the blood vessels, nerves and muscles of the limbs and reduce their functional status. A downer animal must be turned every three hours, day and night.

Moving a bulky animal from side to side can be a near impossible task for two men. However, a 3 m (10 ft) rope can be of assistance if it is drawn under the body by "sawing" forward under the buttocks. One end may be applied around the lower foot and the other end pulled over the body. This technique invariably enables one man to roll an animal quite easily.

The Administration of Drugs

Injections

Equipment

Disposable syringes are widely used; if reusable they should be chemically sterilized between use. The same applies to needles. Blunt needles should not be used. It is important to remember that some diseases can be spread by an infected needle and that a contaminated needle can cause abscesses. Frequent changing of needles form a container of sterilizing agent is an essential procedure.

Filling a syringe. The cap of the bottle should be cleaned with a sterilizng agent and a sterile needle inserted into the bottle. This needle should be left in place and all syringe filling should take place via that needle. This avoids contaminating the material to be injected. Air equal to the amount of fluid dose should be injected into the

bottle. The pressure thus created will fill the syringe more or less automatically if the bottle is inverted.

Restraint

— squeeze chute
— working chute
— stanchion
— halter
— nose lead
— tail jack

Techniques

1. **Subcutaneous Injections** — Medication placed under the skin is absorbed slowly over a long period. If the medication is an irritant, there is considerable likelihood of reaction, swelling and possibly the formation of an abscess.

   The ideal location for a subcutaneous injection is at any point where there is loose skin over a moving part, at a site that is accessible but not dangerous for the operator. The skin over the shoulder blade meets these specifications admirably, although the neck is used by many. The loose fold of skin in front of the brisket is relatively insensitive, and the skin over the chest near the elbow is often used.

   The best needles for use in cattle are from 13 mm to 19 mm (½ to ¾ in.) long and are of from 16 to 18 gauge. The skin should be picked up between the forefinger and thumb and the needle thrust in to its full depth parallel to the underlying structures, making sure that the tip of the needle doesn't lodge in the skin itself, thus blocking the opening of the needle.

2. **Intramuscular Injection** — Intramuscular injections are absorbed relatively rapidly and may be more irritant than can be given by the subcutaneous route. The needle used should also be of 16 to 18 guage and should be 25 mm to 38 mm (1 to 1.5 in.) in length.

   Intramuscular injections must be given into heavy muscled masses away from bones and joints. The limb and thigh muscles are usually used.

   To insert the needle, first remove it from the syringe. The butt of the needle should be grasped firmly between the thumb and index finger, and the needle stabbed sharply into the selected site. The syringe should be attached to the needle and the plunger slightly withdrawn; if blood appears, the needle must be relocated. The injection should be made slowly, as it can be quite painful if given rapidly.

3. **Intravenous Injections** — Injections made directly into the blood stream start to act immediately; however, the procedure is accompanied by risks, the seriousness of which depends on the type of drug being administered. Farmers are advised to seek veterinary advice before attempting to use this route.

4. **Sub-Conjunctival Injections** — In serious cases of "pinkeye" the introduction of drugs into the conjunctiva that lines the upper eyelid has considerable value. Fine needles 13 mm (½ in.) long are best for the purpose. With the head rigidly restrained, the lining of the upper lid may be rolled outwards with upwards pressure to the eyelid; the needle is then inserted beneath the pink membrane. It should be noted that the needle will be passing close to sensitive structures, and this technique is best handled by a veterinarian.

Medicines by Mouth

Medication given by mouth can, if inexpertly administered, be taken into the lungs and cause a serious type of pneumonia.

In Drinking Water

Animals will normally refuse drinking water containing medication. If only medicated water is available and if the concentration of the medication is not too high, certain preparations may be used in this manner. However, the method is only of value in prevention therapy for large numbers of animals.

Drenching

The art of drenching lies in allowing the animal time to swallow. Usually 710 mL (25 oz) bottles are convenient drenching vessels; however, it is essential to attach a 230 mm (9 in.) tube to the mouth of the bottle to avoid the risk of the bottle breaking in the mouth. Old milking machine liners or a length of hose are quite adequate. With the animal restrained in a stanchion or chute, the operator should stand on the left side of the animal's head and place his right hand on the side of its nose below the eyes. The hand should then be slipped into the mouth and the upper jaw held by the dental pad (the toothless upper jaw). The animal will then open its mouth automatically, allowing the operator to slip the tube inside its left cheek. **Do not** elevate the head more than few degrees above horizontal. **Do not** hold the bottle too high so that the mouth is flooded. During this procedure, the animal will chomp and swallow, and thus should drink the medication a little at a time.

Stomach Tubing

The stomach tube may be used to relieve bloat and to administer large quantities of fluid. The tube should be 13 mm to 19 mm (½ to ¾ in.) in diameter with a thick firm wall and it should be about 1.8 metres (6 ft) long. For calves, a human enema tube or special esophageal feeder should be used. Calves have particular needs for colostrum and electrolytes in respect to the treatment of calf scours.

For adult animals, it is best to place a tube guide in the mouth. This is a wooden bar with a hole in the middle. The presence of the guide prevents the animal from chewing the tube and stimulates a swallowing action.

With the animal adequately restrained, the tube is inserted into the mouth. Only gentle pressure is appropriate. If there is little or no resistance, the tube has probably gone into the trachea, breathing will be heard via the end of the tube and the tube will not go so far into the animal. If the tube has passed into the rumen the odor of rumenal contents will come up the tube. If still in doubt, one may blow down the tube and listen in the area of the last rib on the left side for a bubbling sound. The tube on passing down the neck may be palpable from outside, it will penetrate the body further and more resistance will be felt than if it is in the trachea. Coughing is a sure sign that

the tube is in the wrong place. Pumping fluids directly into the lungs will almost certainly KILL the animal. The use of the stomach tubing is not recommended unless the operator has been thoroughly trained in the procedure.

Balling Gun

Many medications may be made up as capsules or boluses — all of which may be administered by the balling gun. Magnets may be given in the same way.

Again, good restraint is important. The balling gun should only be placed over the prominence at the back of the tongue before the ball is released. If used incorrectly, a balling gun can inflict serious injury.

Medications in the Uterus

Taboles

The value of placing anything in the uterus after calving is doubful, to say the least, and it is possible that infection may be introduced.

The operator **must wash** the vulva with disinfectant solution. He **must** use a disposable plastic glove for **each** animal treated.

The taboles should be well separated in the uterus and placed as far forward as possible.

Uterine Infusion

This is a technique that should not be attempted by inexperienced operators.

Topical Medication

Topical medication is medication applied to the external surface of the body, as would be the case in treating ringworm, lice, wounds or pink-eye. When extensive topical dressings are applied, such as for warble control, the manufacturer's instructions must be followed and the operator should wear protective clothing.

Intramammary Medication

Prior to treatment the udder should be completely milked out into a bucket with a little disinfectant in the bottom. Milk from a mastitic quarter is infected, and the infection can be easily transmitted by flies or on the hands.

The teat end should then be disinfected, and the medication should be infused. The quarter then should be massaged to distribute the drug.

INSECT PESTS OF BEEF CATTLE

Insect Pests of Beef Cattle

Cattlemen encounter insect pests all year round in their livestock operations. For profitable livestock production an effective pest control program is a must. Each year insects take their toll of profits through reduced weight gains, decreases in milk flow for the nursing calf, damage to hide and meat, disease transmission and even loss through death of infested animals.

In Alberta there are six major insect pests of cattle. The most important and common pest to all regions of Alberta, the warble fly, cost $1.9 million to the packing industry and around $3 to 4 million to producers (1980 survey). A second pest of major economic importance is the black fly in the north eastern region (Athabasca — Wandering River area). Severe outbreaks of black flies in this region occurred in 1955, 1963, 1964, 1971 and 1972. In 1972 alone 135 animals were killed.

The objective of this section is to provide information to beef producers on:

a) Recognition of insect pest problems.
b) Basic biological features of insects important in prevention and control.
c) Pesticide recommendations for proper pest management.

Cattle Grubs

Biology

Cattle are the only hosts of two species of cattle grubs, the common cattle grub and the northern cattle grub. They are generally referred to as "warble flies", "bomb flies", or "heel flies".

The life cycles of the two species are similar. The grubs, which appear in the backs of cattle in the spring, are familiar to almost everyone who handles cattle. The grub-like larvae drop to the ground, pupate in the soil litter and adult flies which resemble bees emerge. These flies do not sting or feed. They simply mate and lay eggs on the hairs of the lowers parts of cattle. The eggs hatch and the tiny larvae immediately burrow into the skin of the animal.

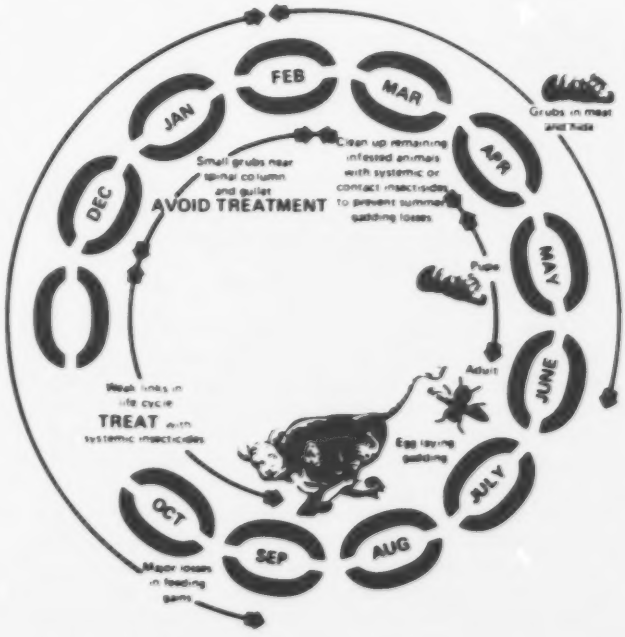


Figure 30. Life cycle of the warble fly

They migrate for several months through the animal body. The grubs reach the esophagus in the case of common cattle grubs, or the spinal canal in the case of northern grubs. The grubs stay at these locations several weeks, then migrate to the back directly beneath the hide. They form breathing holes to the outside at this stage and they are called "warbles". After the larvae are fully grown in the warble cysts, they drop to the ground during the spring and begin their new annual life cycle.

Type of Injury and Economic Loss

Except for the pupa, every stage in the life cycle of the warble fly does some damage to the host animal. The nothern species of the warble fly, during egg laying, attacks and terrifies cattle. The cattle react and run, with tails in the air, to avoid the flies. This is referred to as "gadding". Gadding causes physical injury to animals when they run through fences and into other objects. It also results in reduced gains and milk production. The weaning weights of calves may be reduced by 20 kg (44 lb).

If overwintering larvae in steers are controlled, the animals may gain 0.1 kg (.22 lb) per day more over a 180 day period or an extra 18 kg (40 lb) per steer.

The warble grubs in slaughter cattle cause considerable damage to carcasses and hides. As a result, carcasses are discounted and downgraded. Time involved in trimming damaged carcasses is one of the indirect losses to the livestock industry.

Control

Cattle grubs can be effectively controlled by applying systemic insecticides in the fall to beef cattle and nonlactating dairy animals. The systemic insecticides such as Co-ral, Ruelene, Neguvon, Grubex, Spotton, and others, if applied immediately after the first killing frost, are more effective than a late treatment in November. These compounds are available in spray, pour-on and spotton formulation. For full details on biology and control products refer to Alberta Agriculture publication *Warble Control in Alberta* (Agdex 420/651-1, September 1981).

Cattle Lice

Biology

There are two types of lice commonly found in Alberta, biting or chewing lice and sucking lice. Biting lice feed on outer layers of skin, scurf and dead tissue while the sucking lice feed on blood by piercing the skin.

Cattle lice are specific to cattle and spread from one animal to the next by contact. They are permanently parasitic and spend their entire life cycle on the host. The egg, nymph and adult can all be found on the host animal. The female lice glue their eggs to the hair of the animals and they hatch in one or two weeks. The newly hatched nymphs resemble the adult lice except that they are smaller. The nymphs mature into adults in two or three weeks time and the adult can lay one or two eggs per day for about two weeks. The entire life cycle could be completed in a month's time. The lice occur on cattle all year round but infestation becomes noticeable and severe during winter and spring months.

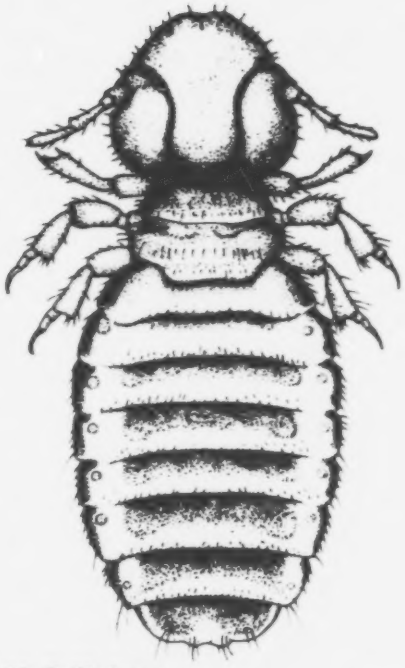


Figure 31. Cattle louse

Type of Injury and Economic Losses

Cattle infested with lice are easy to recognize. Bluish colored patches may appear on the head, neck and shoulders. In severe cases the hair becomes rough, dirty, greasy and polluted with blood from crushed lice. The feeding activity of the lice irritates the skin and the animals rub themselves trying to relieve the itching. The constant rubbing of cattle irritated with biting lice results in open sores which may provide entrance for infectious agents. Extensive irritation makes the animal nervous, edgy, go off feed and fail to gain at a normal rate.

Blood sucking lice can reduce, up to one third, the total number of red blood cells in the animal's body. Insufficient red blood cells may result in anemia, marked by paleness of the eyes and conjuctivae. The anemic cattle become weak and susceptible to respiratory diseases. Pregnant cattle may abort and, with the added stress of cold, sudden death may occur.

It is estimated that in North America the annual loss due to cattle lice is over $6 million. Animals infested with lice are less attractive and the market value of commercial and purebred stock is reduced. Indirect losses such as reduced weaning weight and reduced breeding ability of the bull are also reported to occur in herds where lice are not controlled.

Studies have shown that cattle treated for lice may gain an additional 0.05 to 0.54 kg (0.10 to 1.2 lb) per day depending on how severe the infestation had been.

Control

To prevent the build up of a heavy infestation in a herd, cattlemen should check their animals very early in the fall for signs of lice. It is particularly important to spot a "carrier" animal which becomes habitually lousy each year.

These are a source of infestation to the entire herd and should be eliminated as soon as possible.

A preventive treatment early in the fall with an insecticide effectively controls the population of lice which occurs at this time. This is usually achieved in conjunction with the treatment of cattle with a systemic insecticide for the control of cattle grubs.

A second treatment before the onset of cold weather ensures protection from a severe infestation.

Self-treatment devices such as dust bags, oilers and backrubbers eliminate the work of applying insecticide.

Concentrated pour-on, spotton and dust can be applied to individual animals. For complete recommendations and a detailed life cycle of lice, refer to the Alberta Agriculture publication *Control of Cattle Lice* (Agdex 420/651-2).

Black Flies

Biology

Black flies are among the smallest of the biting flies that attack cattle. They are generally referred to as "buffalo gnats" because of their humped back. They are also commonly known as "sand flies".

There are four stages in the life cycle of the fly. Egg, larva and pupa are found in running water, whereas adult flies feed on animal blood and plant juices. The eggs are laid by the female black fly on or in the water. The larvae remain attached to substrates such as rocks and submerged vegetation. They obtain food through a method called "filter feeding". The larva is transformed into a pupa and remains attached to the substrate until it emerges as an adult fly.

The female black flies, when searching for their hosts, move in swarms that attack cattle and other livestock. The duration of each stage and the number of generations during the summer months varies with the species.

Figure 32. The black fly. The adult of this species is approximately 3.5 mm.

Type of Injury and Economic Losses

Black flies are attracted to host animals in swarms and they fly about often getting into the nostrils and mouth. If they are inhaled, they form a ball of mucous-coated flies which may mechanically choke or suffocate the animal. They feed either on exposed areas of skin around the eyes, ears, nose and mouth, or they crawl into the hair coat. The bites cause severe itching, and swelling and irritation that last for several days. Cattle deaths may result from suffocation and anaphylactic shock. Significant losses in reduced weight gain and reduced milk production have been reported during black fly activity. The weaning weights of calves can be affected because of damaged udders. Numerous bites on the scrotum and sheath of bulls reduce their breeding ability.

Control

Backrubbers charged with insecticide repellant mixtures provide protection from black flies. Installation of these self-administered devices at the entrance of dark or semi-dark shelters have been proven very effective. It has been observed that during severe black fly attacks cattle seek shelter in bush or in semi-dark buildings when they are available.

Larviciding rivers and creeks for controlling black flies should never be undertaken by laymen, but should be entirely the responsibility of professional people and abatement authorities.

Horn Fly

Biology

Horn flies are small dark grey flies about one half the size of a horse or stable fly. They are easily recognized as they rest on animals with their heads facing downwards. They congregate in clusters and always prefer the side of the animal that is in the shade. Unlike other biting flies,

Figure 33. The horn fly. The adult is approximately 4 mm.

they survive on the host animal. After persistently feeding day and night they leave the host animal only long enough to lay eggs in freshly dropped manure.

The female flies lay reddish-brown eggs in the manure and immediately return to the cattle. When the larvae hatch from the eggs and complete their development they migrate down to the soil and are transformed into barrel-shaped dark pupae. Within a few days adult flies emerge and succeeding generations follow each other through the season. The horn flies overwinter as larvae and pupae.

Type of Injuries and Economic Losses

The horn flies are the worst biting species affecting cattle. Their numbers peak in July and August in most parts of Alberta. In heavily infested herds, as many as 3000 to 4000 flies can be found on bulls while the cows and steers will carry 300 to 400 flies per head.

Both male and female flies have beaks which they utilize to obtain blood meals. Studies conducted at the Lethbridge Research Station indicate that 40 or more flies per animal warrant immediate control measures as they lower the performance and productivity of the animal.

It is estimated that 288,000 flies would consume one quart of blood per day. The annual losses from horn flies in Canada have been estimated at millions of dollars.

Control

Several insecticides and methods of application are available for combatting these flies. Horn flies are one of the easiest pests to control as they remain on the animal day and night. Providing access to self-treatment devices such as backrubbers and dust bags is effective. Installing them near a water source and salt licks where cattle visit once or twice during the day is most effective.

Spraying and hand dusting at frequent intervals is labor intensive but provides excellent control. Insecticide eartags are the simplest and most effective method of applying insecticide for the control of horn flies.

For further details please refer to Alberta Agriculture publication *Control of Horn Flies* (Agdex 420 651-3).

Mosquitoes

Biology

There are about 35 different species of mosquito in Alberta. The physical attributes of an adult mosquito are well known to almost everyone. Mosquitoes require water to complete their life cycle. The four stages of the life cycle are egg, larva, pupa and adult. The eggs are laid on or near water. When there is contact with water the eggs hatch and produce larvae or "wrigglers". These can be found in standing water in pastures and along roadside ditches. The larva is transformed into a "comma" shaped pupa called a "tumbler" which swims to shore and in a few days an adult mosquito emerges from the pupa.

The female mosquitoes are blood feeders while the males feed on plant juices. In most of the species there is only one generation per season. All eggs do not hatch at one time. Successive flooding of the pools may produce several broods during the season. Some species of the mosquito overwinter as adults and others in the egg stage.

Type of Injury and Economic Importance

Female mosquitoes require a blood meal before egg laying. Of all the species Aedes, or flood-water mosquitoes are the most serious pest of cattle. Breeding habitats for this species in Alberta are vast and numerous. Severe attacks on cattle occur in the early morning and evening hours. During mosquito attacks cattle exhibit behavior changes such as stampeding, bunching together on higher ground and licking each other to get relief from the bites.

Losses by "mosquito-worrying" of cattle are considerable. In affected areas a drop in milk is noted in dairy cattle.

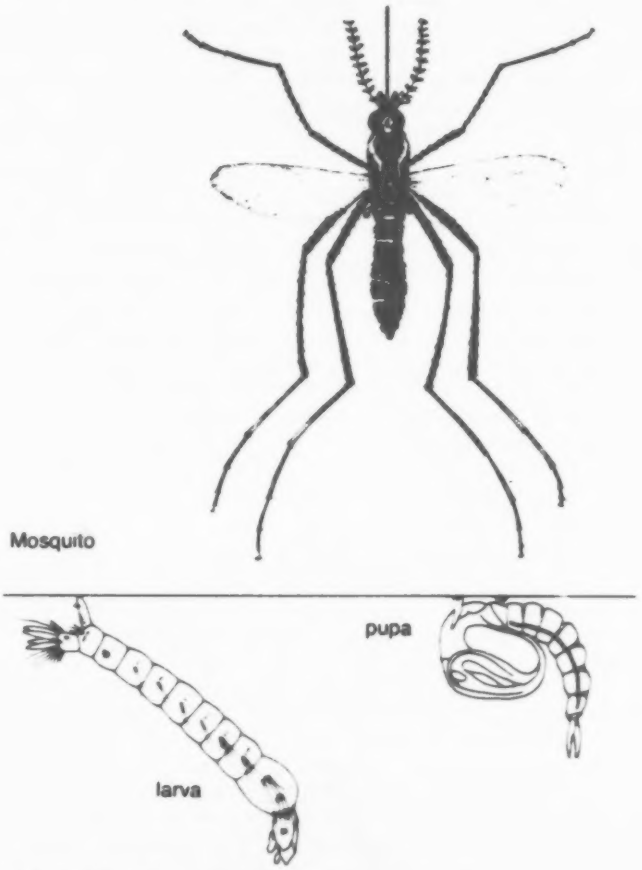


Figure 34. The mosquito

Loss of blood results in poor weight gains and loss of condition. In extreme cases the death of small calves has been attributed to worry and loss of blood.

Control

All mosquitoes require water for the immature stages to develop. Eliminating the sources of breeding, such as rain filled ditches, ponds and shallow pools resulting from the melting of snow in the spring, will greatly reduce the mosquito population.

Protecting cattle from mosquito attacks is possible through frequent application of fast-acting insecticides or insect repellent combinations. This can only be achieved if cattle can be handled frequently.

Organizing an area control program through municipalities is another way of reducing losses caused by mosquitoes.

House Fly

Biology

A common pest well-known to everyone is the house fly. The house fly's annoying habits and the fact that they are a potential vector of many diseases is a concern for public health. The house fly is closely associated with human activity and can utilize a variety of organic matter for breeding and feeding purposes. Livestock buildings and feedlots in particular have an abundance of organic waste suitable for house fly multiplication.

The house fly has four stages in its life cycle: egg, larva, pupa and adult. Eggs are laid in manure, rotting bedding or silage pits where the larvae hatch and pupate in a short time. The entire life cycle is completed in two weeks. House flies overwinter as adults in farm buildings.

Type of Injury and Economic Importance

The role of the house fly as a carrier of livestock diseases has not been extensively studied. It is suspected that many diseases of animals are transmitted by flies as they have ready access to the feces and wounds of infected animals.

House flies worry livestock with their persistent attention and are responsible for loss of condition. Cattle often suffer with inflammation of the eyes during fly time. This condition can be spread through a herd from one animal to another by flies.

Control

Eliminating the breeding sources through proper sanitary procedures reduces fly infestations. Residual wall sprays containing insecticides, fly papers and poisoned baits are some of the methods of control.

A weekly schedule for disposing and spreading cattle manure is the key to good house fly control.

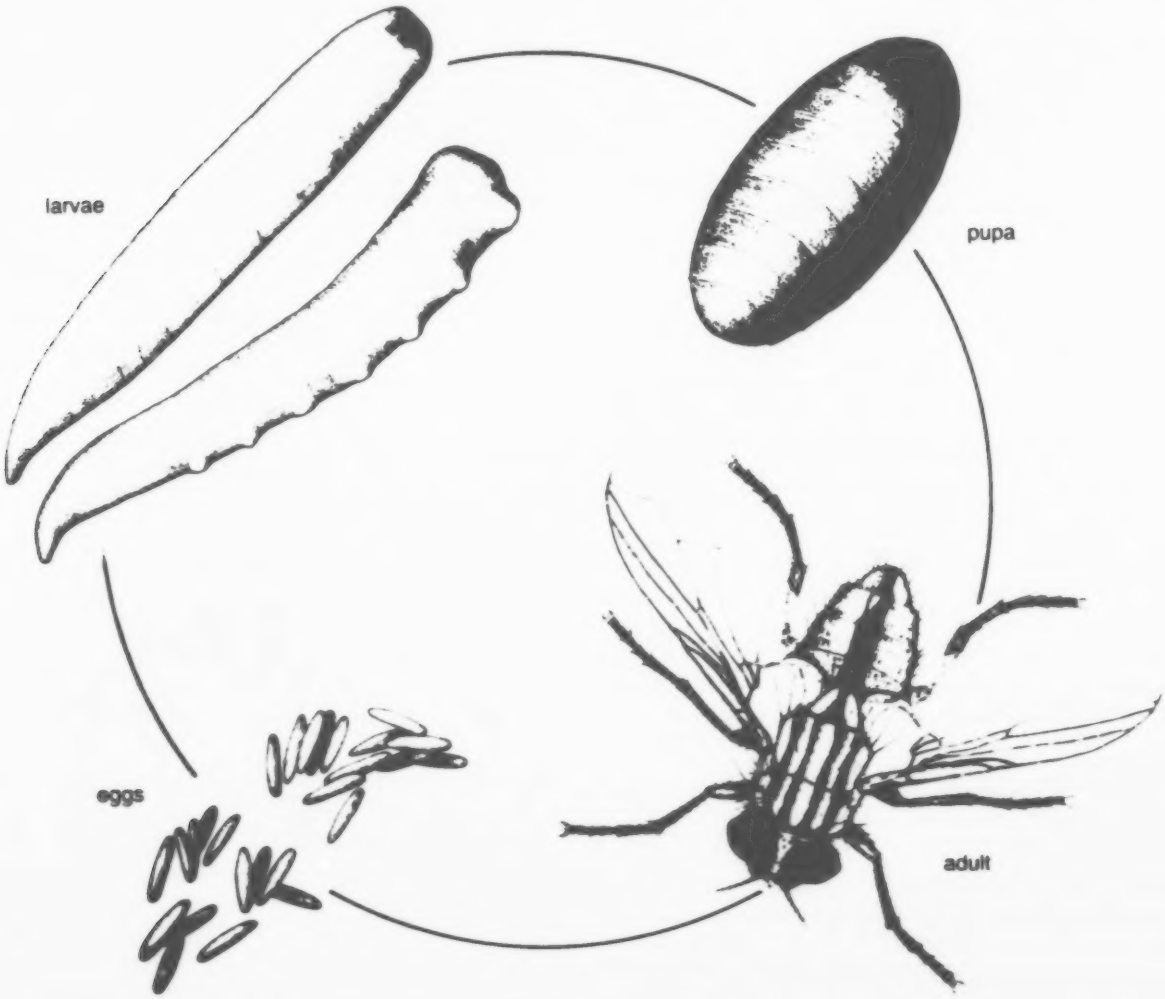


Figure 35. Stages in life cycle of house fly

Stable Fly

Biology

The stable fly resembles the house fly except for a pointed beak held straight out in front of the face. They are also referred to as "biting house flies" or "dog flies". They rest on the sunny sides of the walls of the stable and other farm buildings with the face pointing upwards away from the ground.

Stable flies are not host specific and will attack cattle, pigs, horses, dogs and even man.

The life history and early stages of a stable fly are very similar to that of the house fly. The entire life cycle is completed rapidly in 24 days. Stable flies can produce several generations per season. Wet feed or hay contaminated with manure, urine and mud are particularly good media for development of the stable fly. Decaying weeds along the lake shore or rotten lawn clippings are sometimes the breeding grounds for these flies.

Figure 36. The stable fly. The adult is about 6 mm.

Type of Injury and Economic Importance

Both male and female stable flies bite cattle principally on the legs. When flies are numerous in a barn the cattle get no rest from daylight until dark and continually stamp their feet and twitch their bodies. The bites are very painful because they pierce the skin with their beak and suck blood.

Research has shown that stable flies affect the weight gains of feeder cattle and reduce milk production in dairy cattle.

Control

Eliminating sources of stable fly breeding is the least expensive and most effective method of control, yet it is generally ignored.

The extensive accumulation of larval-sustaining media such as manure, old hay and straw stacks in feedlots and around farm buildings is frequently found responsible for a stable fly outbreak.

Spraying resting areas outside farm buildings also helps to control stable flies.

A light spray of 0.9% dischlorvos solution at the rate of 30 to 60 mL (1 to 2 oz) per head on the legs and lower part of the body is required daily to keep stable flies off cattle.

Face Fly

Biology

The face fly is an important nonbiting fly affecting cattle. This insect resembles a house fly and can only be distinguished by a close examination of the compound eye.

The life cycle of face flies is similar to that of house flies except that the pupae of the face fly are white whereas the house fly pupae are brown. Life stages of the egg, larvae and pupae can be found in cattle droppings in the pasture. Because of a short life cycle, many face fly generations can be produced in one season. Face flies are strong fliers and can travel several miles. They overwinter as adults in animal shelters.

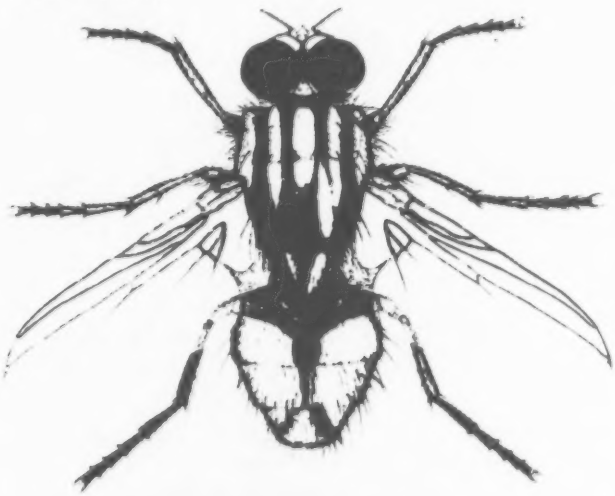


Figure 37. The face fly. The adult is about 8 mm.

Type of Injury and Economic Importance

Face flies have an annoying habit of landing on the face and probing eyes and nostrils. They feed on the mucous secretions and tears produced by persistent probing of the eyes.

In areas where face flies are abundant pink-eye and a condition caused by physical abrasion of the eye have been reported. They may play a role in disease transmission. Fifty or more flies are considered abundant

and can cause economic loss through loss of condition of the cattle.

Control

Face flies do not enter darkened barns and stables. Show animals can be protected by keeping them indoors. Self-treatment devices such as oilers are equipped with face fly mops. Dust bags installed in the loafing areas may provide effective control. New insecticide-impregnated eartags appear to be effective in controlling face flies.

Horse Fly

Biology

There are many species of horse flies that attack cattle and feed on blood.

Adult horse flies are large and sometimes referred to as "bull-dogs". Eggs are laid on stems and leaves of aquatic plants. Larvae are carnivorous and feed on mosquito larvae and other aquatic insects. There is one generation a year. The larvae migrate to damp soil. They pupate in litter zones near the shore of a pond. The pupae hibernate and emerge the subsequent season.

Type of Injury and Economic Importance

Adult horse flies emerge from the overwintering pupae in the latter part of June and in early July. The female flies attack cattle and horses and the bite, which is extremely painful, causes considerable flowing of blood. Often a large number of flies are attracted to the blood pool. A peculiar habit of the flies is that they bite several times before they feed which causes considerable worry to cattle resting in the shade.

Control

It is very difficult to control these flies at the breeding sites. Cattle can be protected by applying chemical repellants frequently during the summer or keeping the animals indoors when flies are active on hot summer days, but unfortunately neither of these methods is very practical for most beef herds.

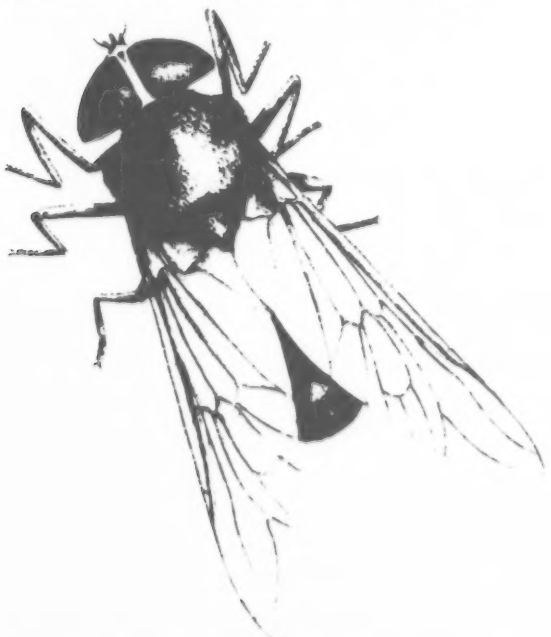


Figure 38. Horse fly. The adult is about 20 to 25 mm.

Livestock Insecticides

Insecticides selected for use on livestock for the control of arthropod pests are specialized chemicals with low vertebrate toxicity and very high toxicity to insects and related groups of animals. They are often classified into contact and systemic insecticides.

Systemic Insecticides

Regardless of their method of administration to the host, these compounds are absorbed in the hosts' system and then ingested by the parasites living in or on the host body. Organophosphorus compounds, such as coumaphos, crufomate, fenthion, phosmet and trichlorfon, are systemic insecticides which are applied to the skin for controlling cattle grubs lodged inside the animal's body or in the warble.

Contact Insecticides

These compounds are toxic only when brought in direct contact with the parasite and are applied directly to the parasites living on the hosts' body or in the warbles. Rotenone and malathion are examples of contact insecticides.

Insecticide Formulations

There are several different kinds of insecticide formulations available. Some are ready-to-use directly from the container while others require diluting and mixing before application.

Wettable Powder or WP

A formulation in which the active ingredient is adsorbed on a carrier material that is wettable in water. This formulation, when mixed with water, forms a suspension rather than a solution. Unless constantly agitated the material will settle out. Pumps that are not thoroughly flushed out with water after use of wettable powders may be damaged or clogged in a subsequent operation. It is important to follow label instructions in mixing and using wettable powders so that difficulties and possible damage in the operation of sprayers may be avoided.

Dusts

Usually a specially prepared formulation **for dry application** in which the active ingredient is diluted with an inert dust to a low concentration for direct application. Wettable powder formulations should not be used as dusts. The rate of absorption of the active ingredient by the skin is usually greater for a wettable powder than for a dust preparation with equal concentrations of active ingredient.

Emulsion, Emulsible Concentrate, or EC

A liquid concentrate containing emulsifiers to keep the active ingredient in uniform concentration in a tank. Requires less stirring of the mixture.

Methods of Insecticide Application

This is to familiarize the user with commonly used insecticide application techniques and terminology. More

specific information is usually provided with the insecticide container. **Reading and following the instructions on the insecticide label is very important for protection of both the human and animal.**

Livestock Spray

Diluted liquid insecticide applied by means of the high pressure spray is the more common method of application. The pressure should be about 2400 kPa (350 PSI). This is important because wetting the skin is necessary for thorough coverage of the cattle; 7 to 14 L (1.5 to 3 gal) of spray per cow or 5 to 7 L (1 to 1.5 gal) per calf may be required.

Mist Spray

Hand operated electric spray (mister) is used for applying small quantities of concentrated insecticides. Mist applicators can also be used as space spray which delivers coarse spray to cover the hair coat of the animal.

Residual Wall Spray

Very low pressure i.e. 550 kPa (80 PSI) is required to apply insecticide to walls, ceilings, fences etc. to the point of run-off. This can be used for controlling house flies and stable flies that rest on the walls. Usually, animals should be removed from buildings before spraying and one should avoid spraying feed and water.

Back Rubber

An inexpensive and effective device for applying insecticides is the back rubber. There are different commercial types available. These could also be manufactured by farmers themselves. A simple form consists of 5 to 6 m (15 to 20 foot) length of cable, chain or wire around which several layers of burlap are wrapped. By regularly resoaking the back rubber with a selected insecticide-oil mixture, these can be used year-round in a cattle operation for controlling various pests.

Pour-On

This method of application was developed for the systemic insecticides. This is a quick and simple method used in controlling cattle grubs. The pour-ons are usually concentrated solutions of either oil or water emulsions poured along the backline of the animal with a small dipper at the rate of 15-30 mL (0.5 to 1 oz) per 50 kg (100 lb) body weight. Pour-on formulations are useful for the treatment of cattle for lice in the winter months.

Spotton

This is very highly concentrated solution of insecticide formulation. There are special applicators for applying these insecticides to cattle. Small dosages, ranging form 4 mL to 20 mL depending on body weight, are applied as spot treatment. Cattle grubs and cattle lice can be effectively controlled by this method.

Dust

A small number of animals may be individually hand dusted with insecticides. Dusts can be applied using a shaker can and working the dust into the hair coat. Dusts are effective against lice and horn flies which are permanently parasitic on the animals.

Dust Bags

Dust bags are self-treatment devices consisting of heavy duty burlap bags with a waterproof coat. These are hung in doorways or installed at the entrance to the watering facilities or mineral salt licks. When the animal bumps or rubs against the bag small quantities of dust sift through the bag.

These could be manufactured on the farm by purchasing insecticide and heavy burlap sacks. This is a less expensive way of treating cattle for lice, horn flies and other insects.

Insecticide Eartags

Insecticide impregnated eartags are the new and simple method for applying insecticides to cattle. The slow release formulations of insecticide spread on the hair coat and other parts of the body when animals groom themselves. Horn flies and face flies are effectively controlled by this method.

Table 34
Insecticide Recommendations for Beef Cattle and Around Farm Building — 1981

Pest	Insecticides
FACE FLIES	1) Crotoxyphos (Ciodrin), 2) Ciovap
HORN FLIES	1) Crotoxyphos (Ciodrin), 2) Ciovap 3) Lindane, 4) Malathion, 5) Methoxychlor, 6) Ronnel (Korlan)
HOUSE FLIES	1) Baytex, 2) Diazinon, 3) Dimethoate, 4) Malathion, 5) Ronnel, 6) Ravap
LICE	1) Carbaryl (Sevin), 2) Crotoxyphos (Ciodrin), 3) Crufomate (Ruelene), 4) Fenthion (Tiguvon), 5) Fenthion (Spotton), 6) Lindane, 7) Malathion, 8) Ronnel (Korlan), 9) Rotenone, 10) Trichlorfon
STABLE FLIES	1) Crotoxyphos (Ciodrin, 2) Ciovap
WARBLE GRUBS	1) Coumophos, 2) Crufomate (Ruelene), 3) Fenthion (Tiguvon), 4) Fenthion (Spotton), 5) Rotenone, 6) Trichlorfon (Neguvon)

Beef Cattle Handling and Housing Facilities

The design of beef cattle facilities is largely a matter of providing the required space, shelter, feed, water, waste management and livestock handling features, adapting them to the natural features of the site, and organizing them for efficient and easy operation.

Handling Facilities

Cattle handling facilities are an essential part of any cattle operation. Well constructed and functional handling facilities contribute much to the easy, safe and rapid handling of cattle.

The handling corrals should be accessible to all pens and located in an area where there will be all-weather access. The main parts of the corral handling system are:

- holding and crowding pens
- working chute
- squeeze chute
- loading chute
- scale.

In addition, most operators will want to incorporate a cutting gate somewhere in the system for the purpose of sorting cattle.

Holding and Crowding Pens — At least one pen is required for holding animals to be worked. The size of pen will depend on the size of herd or feedlot group. Holding pen area recommendations are given in Table 35. Long rectangular pens are recommended for easier cattle removal.

The crowding pen should be about 15 square metres (160 square feet) or large enough to hold one truckload of animals. It should be tapered to funnel cattle into the working chute. A crowding gate in the crowding pen should be designed to facilitate moving animals into the working chute with minimum effort. Curved fences or at least rounded corners encourage the cattle to run along the fence rather than bunch up as they tend to do in square corners.

Table 35
Recommended Dimensions for Beef Cattle Corrals and Handling Facilities

	Less than 270 kg (595 lb)	270-540 kg (595-1,190 lb)	Over 540 kg (1,190 lb)
Holding Area			
— Worked immediately	1.4 (14)	1.7(17)	2.0(20) m^2(ft^2) per
— Held overnight	4.5 (45)	5.0 (50)	6.0 (60) animal
m^2 (ft^2) per animal			
Working Chute w/Vertical Sides			
— Width	450 (18)	550 (22)	700 (28) mm (in.)
— Desirable length (minimum)	7.1 (24)	7.1 (24)	7.2 (24) m (ft)
Working Chute w/Sloping Sides			
— Width at bottom	375 (15)	375 (15)	400 (16) mm (in.)
— Width at top	650 (26)	700 (28)	750 (30) mm (in.)
— Desirable length (minimum)	7.2 (24)	7.2 (24)	7.2 (24) m (ft)
Working Chute & Feedlot Line Fences			
— Recommended minimum height	1,200 (48)	1,350 (54)	1,500 (60) mm (in.)
— Depth of posts in ground	750 (30)	750 (30)	900 (36) mm (in.)
Corrals and Bull Pen Fences			
— Recommended height	1,500 (60)	1,500 (60)	1,800 (72) mm (in.)
— Depth of posts in ground	900 (36)	900 (36)	1,200 (48) mm (in.)
Loading Chute			
— Width	650 (26)	700 (28)	750-875 mm (in.) (30-35)
— Length (minimum)	3.6 (12)	3.6 (12)	3.6 (12) m (ft)
— Rise	1:4	1:4	1:4 rise:run
Ramp height for:			
— gooseneck trailer	375 (15)		mm (in.)
— pickup truck	700 (28)		mm (in.)
— van-type truck	1,000 (40)		mm (in.)
— tractor trailer	1,200 (48)		mm (in.)
— double deck	2,500 (100)		mm (in.)
Access or Collecting Alley Width	3.6 (12)	3.6 (12)	3.6 (12) m (ft)

Note: Cow-calf operations should utilize dimensions for over 540 kg (1,190 lb)

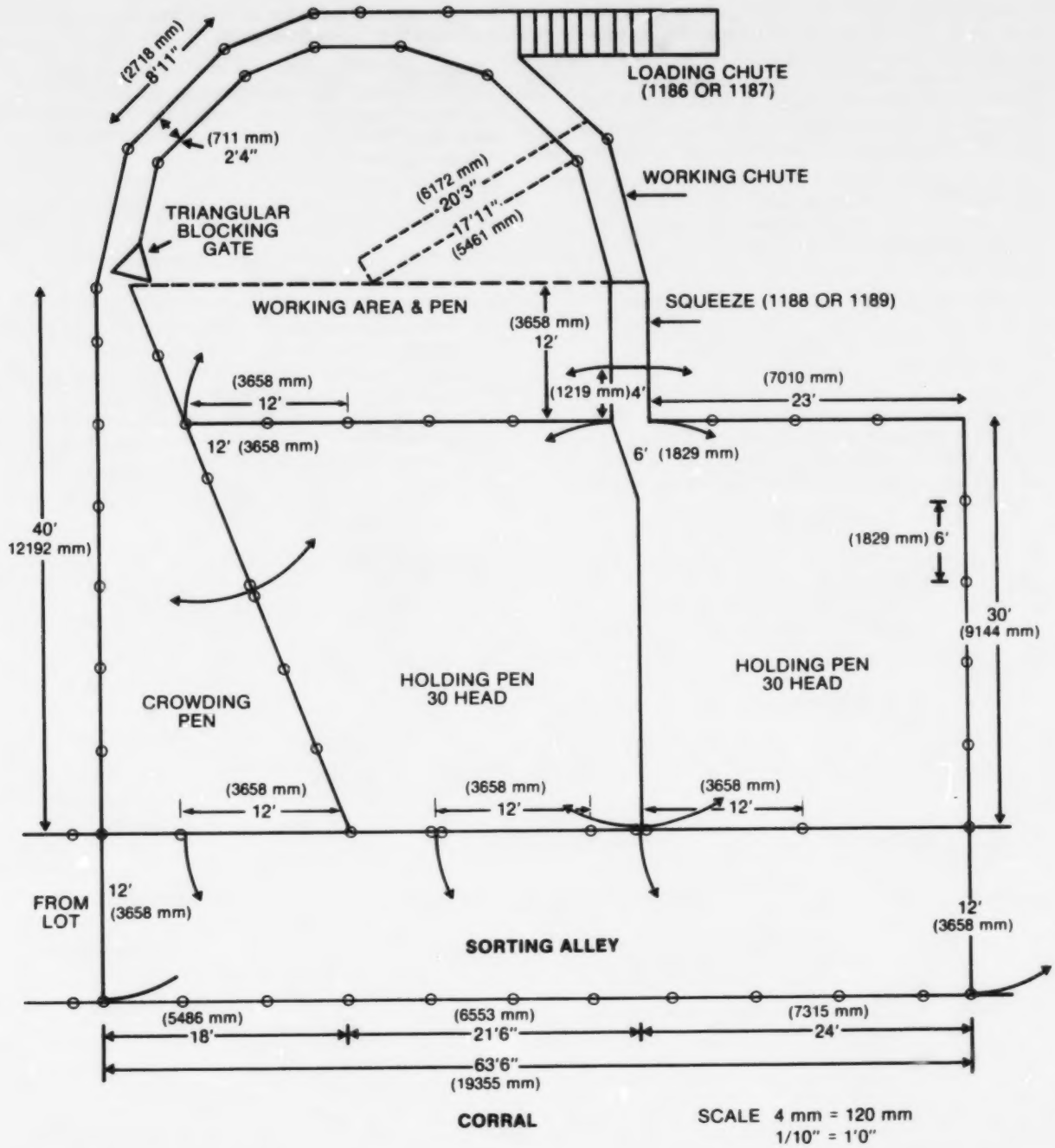


Figure 39: Sample layout of a handling facility

Working Chute — The working chute is the most critical area of the working corral. It must be wide enough for animals to pass through easily but not so wide that they can turn around. See Table 35 for recommended dimensions for both straight wall and sloped wall chutes. Straight wall chutes are easier to construct but the sloped wall chutes better accommodate different sized animals.

Both types of chute should be solid on the bottom half of the sides. This will prevent leg injury and improve cattle movement. The top half of the sides can be either solid or partially open. A concrete floor in the chute is highly desirable.

Animals move best through a semi-circular chute because it curves and they are not looking at a dead end alley. A minimum inside radius of 4.5 metres (15 ft) is suggested to prevent sharp turns. The direction of the curvature will be determined by the side of the animal on which the operator must work. Some jobs can be done from either side, but branding, for example, is specific as to side. A catwalk along one side of the chute will make cattle movement much easier. Blocking gates built in at strategic locations within the chute will help to hold animals in place once they are in the chute.

Squeeze — The squeeze is an essential part of the handling system. It will hold and restrain the animals to facilitate branding, vaccinating, treating, etc. These units can be either homemade or commercially built, but they must be ruggedly built since they will have to take a lot of abuse. There are side opening and front opening units available. A cow-calf operator should choose the one that will best fit into the rest of his system.

Loading Chute — A loading chute may be made permanent or portable depending on which is more convenient for the particular situation. A variable height ramp permits loading cattle on different height truck boxes. A catwalk on the side of the loading chute will enable the handlers to load cattle more easily. Wide steps or cleats on the floor of the loading chute will provide better traction and prevent animals from slipping. For faster and easier loading, the loading chute should be placed off the crowding pen.

Table 36
Guidelines for Housing Beef Cattle (CPS plan 1000)

Requirements	Cows & Bred Heifers	Yearlings	Calves 225 kg (500 lb)
Feedlot (without shed):			
— Hard surface[1]	8 m^2 (80 ft^2)	4.5 m^2 (45 ft^2)	4 m^2 (40 ft^2)
— Soil[2]	30 m^2 (300 ft^2)	25 m^2 (250 ft^2)	15 m^2 (150 ft^2)
— Bedded mound[3]	3.5 m^2 (35 ft^2)	3 m^2 (30 ft^2)	2.5 m^2 (25 ft^2)
Feedlot (with shed):			
Lot Area[4]:			
— Hard surfaced	5 m^2 (50 ft^2) min.	2.5 m^2 (25 ft^2) min.	2.5 m^2 (25 ft^2) min.
— Soil	30 m^2 (300 ft^2) min.	25 m^2 (250 ft^2) min.	15 m^2 (150 ft^2) min.
Shed Area:			
— Floor area	3 m^2 (30 ft^2) min.	2 m^2 (20 ft^2) min.	1.5 m^2 (15 ft^2) min.
— Clear height	3 m (10 ft) min.	3 m (10 ft) min.	3 m (10 ft) min.
Slotted Floors:			
— Space per animal	3 m^2 (30 ft^2)	2 m^2 (20 ft^2)	1.2 m^2 (12 ft^2)
— % of floor area slotted	100	100	100
Maternity pens:			
— Additional area	1 pen/20 cows 3 m × 3 m (10 ft × 10 ft.) min. (not slotted)		
Water:[5]			
— Surface area	0.1 m^2 (1 ft^2)/25 head	0.1 m^2 (1 ft^2)/25 head	0.1 m^2 (1 ft^2)/30 head
Feed Bunk:			
— Length per head:			
— Simultaneous or limited feeding	650-750 mm (26-30 in.)	550-650 mm (22-26 in.)	450-550 mm (18-22 in.)
— Full or self-feeding:			
— roughage	200 mm (8 in.)	200 mm (8 in.)	150 mm (6 in.)
— complete ration	150 mm (6 in.)	150 mm (6 in.)	125 mm (5 in.)
— grain	75 mm (3 in.)	75 mm (3 in.)	50 mm (2 in.)
— Height at throat:	550 mm (22 in.) max.	550 mm (22 in.) max.	450 mm (18 in.) max.
— Max reach (top of throat board to bottom outside corner)[6]	850 mm (34 in.)	750 mm (30 in.)	600 mm (24 in.)
Feed Storage:			
— Hay, without silage	11 kg (25 lb)/head-day (maintenance only)	7 kg (15 lb)/head-day (maintenance only)	5.4 kg (12 lb)/head-day (maintenance only)
— Silage, without hay	34 kg (75 lb)/head-day (maintenance only)	2-2.3 kg (4.5-5 lb)/day /45 kg (100 lb) live wt. (fattening)	16 kg (35 lb)/head-day
— Grain and concentrate	Cows: no grain Fattening 2 yr. olds: 0.7-0.9 kg (1.5-2 lb) /day/45 kg (100 lb) live wt.	May substitute grain for hay at 0.45 kg (1 lb) grain /0.7 kg (1.5 lb) hay	0.7-0.9 kg (1.5-2 lb) /head-day
Bedding Storage (except for slotted fluors):	2.3 kg (5 lb)/head-day	1.8 kg (4 lb)/head-day	1.4 kg (3 lb)/head-day
Manure Storage:			
— With bedding	0.034 m^3 (1.2 ft^3)/day	0.023 m^3 (0.8 ft^3)/day	0.017 m^3 (0.6 ft^3)/day
— No bedding	0.028 m^3 1.0 ft^3)/day	0.021 m^3 (0.75 ft^3)/day	0.014 m^3 (0.5 ft^3)/day

[1] Slope: 2% to 4% on concrete. (Percentage Slope Example: 4% = rise of 4 m for 100 m of horizontal distance.)

[2] Slope: 4% to 8% on soil

[3] Slope mounds 1:4. Sawmill chips and shavings preferred to straw for bedding mounds.

[4] 200 head is the maximum capacity of one pen.

[5] Water demand — average 45 L (10 gal.)/head-day; peak (hot weather) 90 L (20 gal.)/head-day.

[6] Bunk width: 1200 mm (48 in.) if fed from both sides; 1350-1500 mm (54-60 in.) if divided; 450 mm (18 in.) bottom width if fed from one side.

Housing Facilities

Cattle suffer more from mud, harsh winds and excessive moisture than from low temperatures alone. Windbreaks and open front sheds will usually give adequate protection. For winter and early spring calving, a dry draft-free area is desirable. Planned housing and facilities can reduce labor, save time and feed, and keep capital costs to a minimum.

Good tree groves make excellent windbreaks. Pens built 30 to 45 metres (100 to 150 feet) downwind from the windbreak will allow room for snow to get trapped before it gets into the pens. Windbreak fences are a good alternative (20% open and 80% solid) and a minimum of 2.5 metres (8 feet) high.

In order to provide protection from wet snow, rain, wind and extreme temperatures, open front sheds are often used. These normally are naturally ventilated buildings and the most common are of a pole construction. A single sloped shed is the least expensive to build. The runoff from the roof goes to the back of the shed and the sunlight normally reaches to the back of the shed. The open front clear span buildings can allow a deeper shed which will reduce the amount of snow entering the building. It also allows for easier entry with a tractor and scraper for cleaning the shed. The open-end pole barn will help modify winter temperatures but one can encounter moisture problems if relying strictly on natural ventilation.

Some of the more intensive livestock operations have gone to total confinement barns for feeder cattle. These are insulated buildings with totally slotted floors over liquid manure pits. In this system, the space per animal is reduced to a minimum, the routine barn cleaning chores are virtually eliminated and the animals remain quite clean.

A cool dry calving barn is much more desirable than a warm humid one. A common practice is to make pens in the back of an open front shed. If these pens are kept well bedded and a heat lamp or infra-red lamp is used, the conditions will be quite comfortable. Avoid completely enclosed buildings unless they are fully insulated, ventilated, and heated.

For complete construction plans for buildings and equipment and for more detailed information, contact your local district agriculturist, regional livestock supervisor or regional agricultural engineer.

Scale — A scale is essential for accurate performance records of cattle. Scales can either be fixed or portable, single or platform. A scale should not be placed in line with the working chute. This would mean that every time an animal is put through the chute it would pass over the scale. This puts extra traffic on the scale. Use a bypass from the working chute below the squeeze. The location of a platform scale is not as critical but it should be located so feed can be weighed as well as cattle.

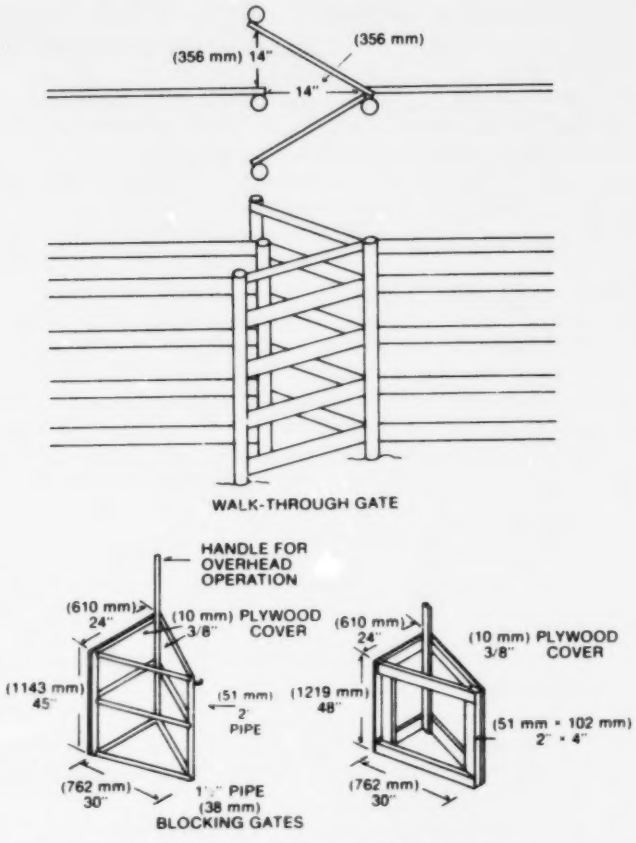


Figure 40. Walk-through gate and blocking gate

Additional Features

Hospital Pens — A hospital or sick pen is a useful addition to any cattle lot, and a necessity in larger ones. It eliminates the necessity of cutting an animal from the main herd each time it is to be treated. This eliminates stress on both the ailing animal and the operator, especially where daily treatment is required for a period of time.

Sick pens should be located near the working facilities and should be sheltered and well bedded. Space requirement are not large — 1.5 to 2.0 m^2 (15 to 20 ft^2) for shelter plus 4 to 6 m^2 (40 to 60 ft^2) of lot per head based on 5% of the herd.

Walk-Through Gate — (Figure 40) — saves time when passing through a fence. Whatever the operator may be carrying does not have to be set down to open and close a gate. Cattle cannot pass through this type of gate.

Power Outlet — This is almost a must somewhere near the squeeze. Electric clippers, dehorners, branding irons and even an electric heater for warming equipment or tools during cold weather are commonly used here. A yard light in the same general area will light up the whole working area.

Range and Pasture Management

Range management is the care and use of range and pasture to get the highest continuous yield of animal products without endangering the forage plants, the soil, water resources and other important uses of land. Animal products of the range are meat, wool and hides. Other aspects of importance to the range are water, wildlife and recreation.

The goals of range management are to:

1. Keep the range covered with good forage plants.
2. Maintain a range feed reserve.
3. Increase livestock and wildlife products.
4. Increase the water-holding capacity and even out the flow of water from the range.
5. Control soil erosion.

It is important that a rancher makes a good estimate of how much of the range is overstocked and how much is understocked. Understocking leads to an uneconomic operation. Overstocking will reduce the productivity of the range by reducing the palatable plants and increasing the weedy, unpalatable, nonproductive species. Overgrazed rangeland is subject to water and does not retain enough cover to catch and hold snow, and loses moisture through run-off of summer rains.

Stocking Rates

There are several terms which apply to carrying capacity. The following terms and equivalents are used.

Animal Unit (A.U.) — considered to be one mature 450 kg (1,000 lb) cow or the equivalent based upon average daily forage consumption of 11.8 kg (26 lb) of dry matter per day.

Animal Unit Month (AUM) — the amount of feed or forage required by an **animal unit** for one month.

Animal Unit Equivalents

Bulls, 2 years or over	1.50
Mature cows with or without an unweaned calf	1.00
Yearling steers or heifers	0.67 - 0.75
Weaned calves	0.60
Yearling Horses	0.75
2 year old Horses	1.00
Horses 3 years old and over	1.50
5 Ewes or Does with or without Lambs or Kids	1.00
5 Rams or Bucks	1.30
5 Weaned Lambs or Kids up to 12 months	0.60
5 Deer	1.00

Stocking rates can be expressed in acres per animal unit month (Ac/AUM).

Acres per Animal Unit Month (Ac/AUM) — This term refers to stocking rate — the number of acres required to produce the amount of forage required to feed an animal unit for one month.

The range areas can be divided into six grazing zones. The rangelands in Alberta vary with soils and climatic regions. The range areas are shown in Figure 41.

The needle-and-thread blue grama range is the most important in zone 1. The annual precipitation is usually less than 356 mm (14 inches) and the mean annual temperature is over 3.3°C (38°F). Zone 1 is the Brown soil zone. The average stocking rate is 4.2 acres per AUM.

The needle-and-thread blue grama/wheat grass range is the most important in zone 2. The annual precipitation ranges from 356 mm - 457 mm (14-18 inches). Zone 2 occurs in the Brown and Dark Brown soil zones. The average stocking rate is 3.5 acres per AUM.

The Western porcupine grass/wheat grass range occupies zone 3 in part of the Dark Brown soil zone. The average stocking rate is 2.5 acres per AUM.

Rough fescue range is important in zone 4. The annual precipitation ranges from 457 mm - 610 mm (18-24 inches). The soils range from Thin Black to Black. The average stocking rate is 1.7 acres per AUM.

The parkland range occupies zone 5. It is characterized by aspen-poplar bluffs, intermixed with prairie varying from a fescue grassland to the western porcupine grass grassland. This is located on Dark Brown and Thin Black soils. The average stocking rate is 3.3 acres per AUM.

Brush pastures occupy vegetation zone 6. These are located on the Black and Gray Wooded soils of Alberta. The cover is characterized by the presence of aspen, balsam poplar and willow trees. The average stocking rate is 5 acres per AUM.

Table 37 shows the stocking rates for the grazing zones of Alberta based on range condition. Range conditions may be classed as excellent, good, fair or poor. As the plant cover deteriorates from one class to another, it produces less forage and the forage is of poorer quality.

Range conditions or range health are measured by how much the vegetation has changed from the original cover. The greater the proportion of forage provided by the original or climax vegetation, the better the range condition.

Range conditions based upon the percentage of forage yield derived from climax plants, can be classified as follows:

Excellent	75 - 100%
Good	50 - 75%
Fair	25 - 50%
Poor	0 - 25%

The stocking rates, with an allowance for carryover, are calculated so that range in excellent or good condition will be maintained, while those in fair or poor condition will be improved.

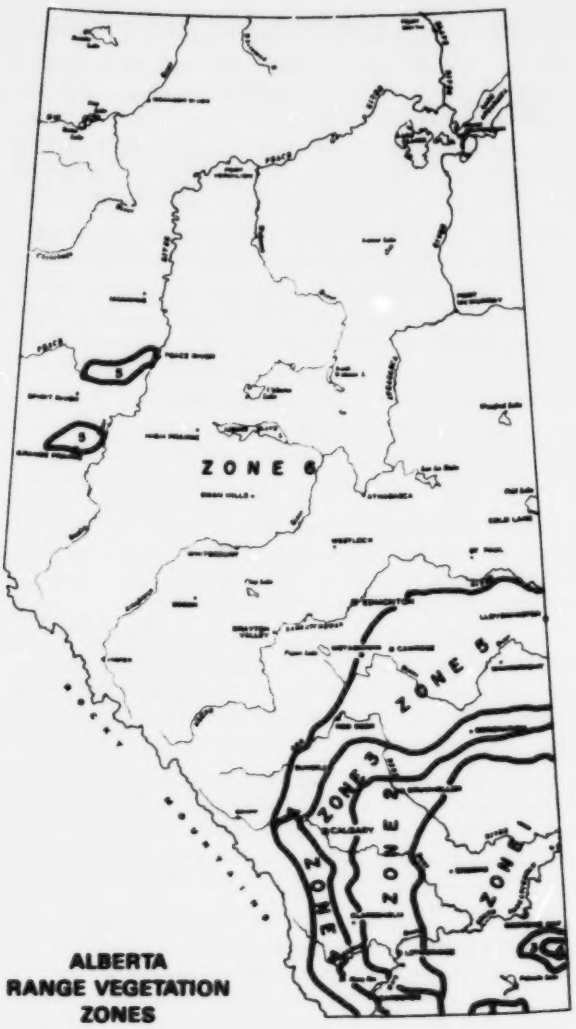


Figure 41.
Alberta range vegetation zones

For these reasons, most ranchers manage their lands to improve forage condition if it is below excellent. The stocking rate values apply to average sites and average climatic conditions. There is considerable variation in stocking rates within each zone depending on slope, range condition and the presence or absence of tree cover.

Tame pastures are generally used in conjunction with rangeland. Table 38 shows the stocking rate estimates for the various zones based on pasture health or condition. Excellent and good condition stocking rates represent the variation in production encountered in an acceptable stand of a pasture mix of adapted grass and legume species.

The fair condition stands represent a situation where production is low enough that the pasture should be appraised critically. Can the production be improved by modifying the grazing practices, is fertilization necessary, should the pasture be cultivated and reseeded?

The poor pasture condition represents a stage where production is low enough that one has no alternative but to totally renovate by cultivating and reseeding. This would represent a pasture where the desirable species have been replaced by undesirable ones. This may be a pasture with a large population of weeds or where the good forage plants have been grazed out.

The stocking rate in Table 38 applies to average soils and climatic conditions. There may be variation in stocking rates in each zone as a result of variation in rainfall and soil conditions.

Table 37
Stocking Rates for Alberta Native Range in Acres Per Animal Unit Month (Acres/AUM)

Zone		Range Condition			
		Excellent	Good	Fair	Poor
1	Needle-and-thread, blue grama type	3.5	4.2	5.2	7.5
2	Needle-and-thread, blue grama, wheat grass type	2.7	3.5	4.2	6.2
3	Western porcupine grass, wheat grass type	2.0	2.5	3.2	4.2
4	Rough fescue type	1.2	1.7	2.5	3.2
5	Parkland type	2.7	3.3	4.2	5.8
6	Woodland pasture type	4.0	5.0	6.0	8.5

Table 38
Stocking Rates for Alberta Tame Pastures in Acres Per Animal Unit Month (Acres/AUM)

Zone	Pasture Health			
	Excellent	Good	Fair	Poor
1	1.3	2.0	2.7	4.0
2	1.0	1.5	2.0	3.0
3	0.7	1.0	1.3	2.0
4	0.5	0.7	0.9	1.4
5	0.3	0.5	0.7	1.0
6	0.3	0.5	0.7	1.0
Irri.	0.2	0.3	0.4	0.6

How to Use Tables 37 and 38 — You can use the stocking rate table in estimating the carrying capacity of your range or pasture.

Suppose your land is in zone 1 near Medicine Hat. After examination it is found to be in good condition with above average site quality.

Locate zone 1 in Table 37 and read across the range condition classes until the appropriate column is reached. Under good condition in zone 1 the stocking rate indicated is 4.2 acres per animal unit month. If grazing for 100 cows for five months is required, the range needed would be 5 months × 4.2 acres × 100 animal units = 2,100 acres.

If a pasture of 600 acres of the same type were to be stocked, 600 ÷ 4.2 = 143 AUMs could be harvested each year. This works out to be 143 ÷ 5 = 29 AUs for 5 months, or 143 ÷ 6 = 24 AUs for 6 months.

If yearlings are to be grazed the number can be calculated by dividing the animal units for 5 months by 0.67 (1 yearling = 0.67 — 0.75 AU).

29 AU divided by 0.67 = 43 yearlings for 5 months.

Similarly, on tame or irrigated pastures the same method may be used using the stocking rates in Table 38.

E.g. — 100 acres irrigated pasture rated good:
100 divided by 0.3 = 333 Animal Unit Months **OR**
333 divided by 5 = 66 cows or Animal Units for 5 months.

Table 39 shows the stocking rate conversions of AUMs per acre to Acres per AUM, Acres for 6 months, Acres for 9 months, and Acres for 12 months. The stocking rate expressed on grazing leases is usually in **acres** per animal unit grazing for 12 months.

Table 39
Conversions of AUMs Per Acre to Acres Per AUM

AUM per acre	Acres per AUM	Acres for 6 months	Acres for 9 months	Acres for 12 months
.1	10.0	60	90	120
.15	6.7	40	60	80
.2	5.0	30	45	60
.25	4.0	24	36	48
.3	3.3	20	30	40
.35	2.9	17	26	34
.4	2.5	15	23	30
.45	2.2	13	20	26
.5	2.0	12	18	24
.6	1.7	10	15	20
.7	1.4	8	12	16
.8	1.3	7	11	15
.9	1.1	6.6	10	13
1.0	1.0	6.0	9	12
1.2	.8	4.8	7	10
2.0	.5	3.0	5	6

Grazing Management

Carryover

Carryover is the amount of forage that is left when grazing ends. On native range it should be 45% of the current growth, and 20% of the seed stalks should remain uneaten. Green plants manufacture their own food; when they are grazed moderately some of this food is used for further growth and some stored in the roots. The food manufacturing process stops when all the leaves are removed. Plants depend on root reserves to produce new growth and die when reserves are depleted. Carryover provides the reserve to maintain yield.

A carryover of 45% each year is impractical because production varies from year to year. This variation may range from 35 to 250% of average production of forage. The 45% carryover is an average value which the proper stocking rate will yield over a period of years.

The concept of carryover on tame pastures is not emphasized the same way as with native range. Instead a utilization of 70-75% is considered proper use. This is usually estimated by average stubble height when the cattle are rotated. Although proper use according to height varies as to species sown, a rule of thumb would be to remove the cattle when the average stubble height in the pasture reaches 75-100 mm (3-4 inches). The plants die when all the leaves (food factory) are removed through grazing.

Grazing Season

There are two concepts derived from the term grazing season. One is concerned with the safety and nutrition of the animal and the other is concerned with range condition and productivity. The following remarks are concerned with maintaining range condition.

Grazing should be delayed until the grasses have produced green leaves and are manufacturing and storing

food, unless an adequate stockpile of old bottom has been accumulated. Thus range "readiness' varies from year to year. It is suggested that dates of readiness for grazing can be linked with the flowering of well-known plants. For zones 1, 2 and 3, grazing should not start until the buffalo bean is in full flower, usually in late May. For zone 4, range readiness is when the shooting star is flowering, and for zone 5, the native rose.

Another reason for delaying grazing in the spring is that different grass species start growth at different times which may vary as much as 6 weeks. Also, the longer grazing is delayed in the spring the greater the forage yield.

In some cases it may be impractical to delay grazing until late spring, especially if the livestock have to be fed. However, this may be overcome through changes in management. Ranchers may adopt a grazing system or rotation which allows them to use different fields for spring grazing in consecutive seasons. Another common practice is to reseed areas to early growing species of tame grass, such as crested wheat grass, for spring use.

Grazing Systems

Any consideration given to grazing systems or a rotation should include objectives such as improvement or maintenance of range condition, increased stocking rate, or improved animal performance.

Forage production may be increased by improving the health or condition of the range. Range condition is the state and health of the range based on what the range is naturally capable of producing. The common practice is to rest an area for one full season. A more feasible approach is to defer grazing in the spring and graze it late in the season. This is a more economical method of improving range condition.

One of the reasons for using a grazing animal to harvest forage is that this method is inexpensive. However, this advantage may be lost because of uneven utilization. A grazing animal will tend to graze patches and leave other patches. A system that allows larger numbers of grazing animals on an area for a short period is advantageous because it forces animals to utilize the area more uniformly.

Table 40 gives an example of a deferred rotation. The object is to obtain spring grazing from native range as well as maintain or improve the range condition. It allows each field to rest in the spring or summer season once every three years. Each field is always grazed in the fall when the range is least susceptible to grazing damage. Any grazing system has to be designed to suit an individual ranch operation.

On the other hand where range conditon was good and where no serious distributional problems existed, the rotation shown in Table 40 was found to be no better than continuous summer use (Manyberries Research Station.)

Table 40
An Example of A Deferred Rotation

Pasture	First Year			Second Year		
	Spring	Summer	Fall	Spring	Summer	Fall
No. 1	Grazed	Ungrazed	Grazed	Deferred	Grazed	Grazed
No. 2	Grazed	Ungrazed	Grazed	Grazed	Ungrazed	Grazed
No. 3	Deferred	Grazed	Grazed	Grazed	Ungrazed	Grazed

Grazing Distribution

When grazing animals are used to harvest a forage crop they must be manipulated to graze as uniformly as possible. If left to their own devices, the livestock will continue to graze small areas and keep them closely grazed while leaving other areas relatively untouched. The tools available to induce more uniform grazing include water supply locations, salt or supplement locations, rotations, cattle oilers or rubbing post locations, shelter locations and riding.

The objective in developing water supplies is to provide a more even distribution of animals over the range, and thus use areas which would be wasted because of lack of water. Cattle should not have to travel farther than 3.2 kilometres (two miles) in flat country and no more than 0.8 kilometres (half a mile) in rough country. Natural water supplies can be improved by cleaning out and preserving springs, seeps, and swamps. Artificial development involves digging wells and reservoirs.

Salt or supplement location is another tool to obtain better grazing distribution. Animals usually seek out salt. Therefore, to improve distribution, salt should be placed away from water in areas where animals are not grazing. If moved periodically, the animals usually follow the salt.

Cattle oilers, rubbing posts and shelters can be placed strategically to improve distribution in a field.

Fencing will facilitate grazing rotations and will manipulate livestock location to improve grazing distribution. The first requirement is to restrict cattle to the grazing land. The second is to force livestock into areas not usually frequented. Riding or herding is being used instead of fencing in areas such as Alberta forest reserves to distribute grazing. The cost of labor versus the cost of fencing usually determines the method adopted.

Range Improvement

The objectives of range improvement are usually to improve the quality and quantity of forage for increased animal production. The methods available are numerous, but may be summarized thus: improving the efficiency of harvesting the present forage supply, increasing production by improving the range condition, and replacing native range with introduced forage species.

Fertilization

Fertilization of native range is not usually recommended because most range areas contain a mixture of grasses, broadleaved plants and shrubs. The fertilizer is utilized by plants not grazed by cattle. Research on prairie range land has shown that where moisture was adequate, increased yields were realized, but not enough to make fertilizing an economic operation. The same research showed that where moisture was adequate the increased yield on tame pasture was usually profitable. Tame forage operations should include a fertilizer program based on soil testing.

Reseeding

Research has indicated that in the prairie areas of Alberta, production can be increased three-fold by reseeding native range with adapted forage species on the better soils.

The first consideration when reseeding in dry areas is to establish spring pastures with crested wheat grass or perhaps Russian wild-rye. Native range is not well suited to intensive spring use because it is easily damaged. Crested wheat grass is ready for grazing some 6 weeks earlier than native prairie and produces 90% of its annual yield before July 1. Native range will yield more when used as summer and fall pasture as opposed to spring pasture. Crested wheat grass is excellent for spring pasture, but it tends to become unpalatable later in the season. Generally, because of its limited season of use, no more than 20 to 25% of a ranch unit should be seeded to crested wheat grass. Russian wild-rye also starts growth early in the spring but remains palatable long into the fall. Russian wild-rye has proven to be outstanding for summer and fall pasture, and retains a relatively high nutritive value in later summer and fall. Many ranchers consider the extra year it takes to establish a stand to be compensated for by the versatility of Russian wild-rye grass. Figure 42 shows a grazing calendar with the seasons during which some introduced forage species may be used advantageously in conjunction with native range.

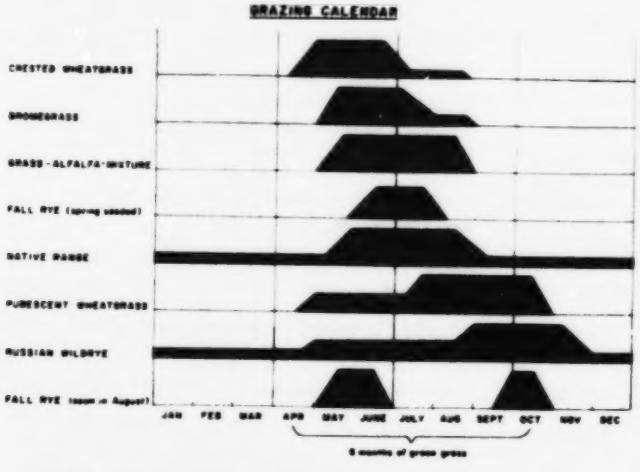


Figure 42. A grazing calendar

The principle in range reseeding is to kill all existing vegetation and seed the forage species into the firm seedbed on fallow or stubble in the fall or early spring. Row spacing is important in the prairie areas. Crested wheat grass sown at 457 to 610 mm (18 to 24 inch) row spacing will yield much more forage than the same grass sown at 152 mm (6 inch) rows in the Brown soil zone. Recommended row spacing is shown in Table 41. Stands of tame forage with wider row spacing usually remain productive for a longer period of time than stands established by solid seeding. Crested wheat grass with proper row spacing has remained productive after 40 years.

Table 41
Row Spacing Recommended for Range Reseeding

Vegetation Zones	Spacing in mm	Spacing in inches
1	457 - 610	18 - 24
2	305 - 457	12 - 18
3	305 - 457	12 - 18
4	178 - 305	7 - 12
5	152 - 178	6 - 7
6	152 - 178	6 - 7

In managing a combination of tame pasture and native range it is usually more efficient to graze tame pastures in separate fields. However, research at Manyberries indicates that livestock will rotate themselves at different seasons where crested wheat grass, Russian wild-rye and native range are available in the same field.

Range production varies with May-June precipitation. Reseeded areas help stabilize the production fluctuation in that the forage can be harvested as hay in high precipitation years and grazed in low precipitation years.

Annual Crops

Annual crops such as oats may be used to stabilize forage production of perennial pastures. A summerfallow field can be divided into four areas providing access, fencing and water supplies are adequate. (An electric fence makes a good temporary fence). Seed one area in mid-May and the remaining areas at 2 or 3 week intervals. This will allow a continuing supply of oat pasture. If not required for pasture, the oats could be harvested as grain or green feed. This method makes provision for a more stabilized grazing supply as well as increased source of winter feed. If properly stored, the winter feed supply can be carried over to another year. Annual crops are good insurance and provide emergency fodder when required.

Brush Pastures

Brush pastures that occupy vegetation zones 5 and 6 are important for raising cattle. However, the grazing season is short. The native plants lose their nutritional value after the first killing frost and produce little forage before the middle of May or beginning of June.

Range improvement becomes important in terms of reseeding to increase grazing production. Because of the high cost of clearing and breaking, the best soils should be selected to be seeded to improved grasses and legumes. Large scale projects using rough or once-over methods are seldom successful owing to poor forage establishment and

the woody regrowth. Small clearing and breaking projects using annual grain cropping for one or two years to ensure adequate brush removal and to partially defray the expense are recommended. These projects should be scattered throughout a brush pasture to distribute livestock and to make full use of the short season of the native range. In some cases, brush suppression using chemicals may be useful.

Native forage plants in brush covered areas do not tolerate heavy use. If too heavily grazed the palatable forage plants will be grazed out.

Very close grazing of seeded pastures should be avoided as it reduces the yield. In zones 5 and 6, grass-legume mixtures should be allowed to grow 3 to 4 inches before freeze-up. Creeping red fescue in good condition usually produces reasonable fall grazing whereas the softer grasses such as brome do not.

Other Publications of Interest To Beef Producers

Alberta Agriculture, Print Media Branch

Agdex No.	Title
FS120/32	Varieties of Hay and Pasture Crops for Alberta. (Annual).
FS120/60-1	Principles of Forage Conservation. Revised 1979.
FS127/20-4	Perennial Grasses for Hay and Pasture. 1978.
FS130/10-1	Principles of Pasture Management. 1977.
134/14	Grazing Systems for Alberta Ranges. Revised 1979.
134/14/1	Alberta Range Pastures. Revised 1979.
134/14-2	Management of Prairie Rangeland. AC 1589, 1976.
FS134/14-6	Pasture and Range Management for Alberta. 1976.
FS134/14-7	Management and Improvement of Rangeland. 1978.
135/20	Irrigated Pastures for Cattle in Western Canada. AC 1526, 1974.
FS700/6	Metric References for Livestock
400/02	Annual Feeder's Day Report. U of A. (Annual).
400/20	Livestock on Small Farms. AC 1381, 1975.
FS400/21	Reproductive Features of Farm Animals. 1977.
FS400/50-3	Nutrients for Cattle. 1979.
400/52	Feeding Livestock on Low Roughage Rations. AC 1287, 1967.
FS400/65-1	Chemical Analysis of Water for Livestock Use. Revised 1980.
400/69	Water Requirements for Livestock.
400/666-1	Problem Feeds for Livestock & Poultry. AC 1701 - (1980).
FS851	Chemical Control of Cattle Insects. Revised 1979.
FS400/663-1	Blackleg and Allied Diseases. 1977.
FS420/22-1	Calving. 1976.
420/35-3	Reproductive Performance of Foreign x Domestic Hybrid Cows Under Two Management Systems. AC 1632, 1977.
420/35-4	Postweaning Growth and Carcass Traits of Yearlings from Red Angus and Beefmaster Sires with Exotic First-Cross Dams. AC 1663, 1977.
FS420/35-5	Reproductive Evaluation of Bulls. 1981.
420/36	Artificial Insemination of Beef Cattle.
420/41-3	Beef Cattle Performance Selection. (Reprint from AC 1480) 1972.
420/41-12	Beef Cattle Performance Test. (Annual Report).
FS420/42-1	Identification Systems for Beef Cattle. 1978.
420/42-2	Preweaning and Postweaning Performance of Progeny Sired by Charolais, Simmental, Limousin, and Chianina Bulls Mated With Exotic First-Cross Dams. AC 1682, 1979.
420/42-3	Carcass Characteristics of Progeny Sired by Charolais, Simmental, Limousin, and Chianina Bulls Mated With Exotic First-cross Dams. AC 1683, 1979.
FS420/50-1	Winter Feeding Programs for Beef Cattle and Calves. Revised 1979.
420/50-2	Feeding Beef Cows and Heifers. AC 1670. 1979.
FS420/52-1	How to Formulate Rations for Beef Cattle. 1980.
420-56	Creep Feeding Calves.
420/651	Control of Cattle Grubs in the Prairies. AC 1309, 1973.
FS420/651-1	Warble Control in Alberta — 1979-80. Revised 1979.
FS420/651-2	Control of Cattle Lice. Revised 1980.

FS420/651-3 Control of Horn Flies. 1979.

FS420/662-1 Disease Control Calendar for Beef Cattle. 1980.

420/723 Farm and Ranch Equipment for Beef Cattle. AC 1390, 1975.

FS651 Chemical Control of Cattle Insects. Revised 1980.

663-1 Brucellosis. AC 1552, 1975.

663-5 Calf Scours, Veterinary Infectious Disease Organization. 1978.

666 Stock-Poisoning Plants of Western Canada. AC 1361, 1973.

666-1 Problem Feeds for Livestock and Poultry in Canada. AC 1701, 1980.

771.1 Snow and Wind Control for Farmstead and Feedlot. AC 1461, 1971.

FS716(C52) Automatic Livestock Waterers. Revised 1978.

724-2 Farm Pasture Fencing. AC 1568, 1976.

726-1 Farm Feed Processing and Handling. AC 1572, 1976.

FS732-2 Vertical Silos and High Moisture Storage Structures. 1976.

FS732-3 Horizontal Silos. 1976.

FS732-7 Baled Hay Storage. 1977.

812 Agricultural Leasing. 1975.

FS812-2 Pasture Rental Fees. 1977.

FS812-3 Cow-Calf Leasing Arrangements. 1979.

824-2 Fencing Costs (Budget Information and Worksheets). 1980.

Western College of Veterinary Medicine
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Veterinary Science in the Care of Beef Cattle

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